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The Haste for Legislation

There seems to have developed in Washington a desire for much haste to enact a law regulating business, an undue anxiety to get something done. It is not so important to get something done as it is to make sure that when something is done it will do good and not harm to business. In view of the complex problems involved and the lack of agreement on the proposed legislation, the postponement of definite action until the next session of Congress would provide time for study and the crystallization of a sane policy. Delay would be preferable in every way to a law working serious damage. The country is not so much in need of reformatory legislation as it is in need of more business. To any reasonable legislation business can conform without dire results. To any unreasonable or revolutionary legislation, such as some propose, business cannot conform without very serious results. Therefore Congress should think less about getting any kind of a law passed and more about getting a law passed that will actually benefit business. Everybody is agreed that business needs a stimulant. It will be stimulated by the manifestation of a sane attitude in Washington regarding business legislation. The opportunity is one that Congress should not reject lightly. It has a responsibility for which it will have to answer. In tampering unduly with the practices of commerce Congress is playing with interests upon which the prosperity of the country primarily depends. If it cannot legislate now without grave disturbance to those interests, it should wait. Disturbance of business interests means disturbance to every interest in the land.

Commissioners Who Leave Office

The question of what becomes of men who retire as public service commissioners concerns both the public and the companies. We speak not of those who are so inefficient that they can well be spared from the commission but of those who have rendered faithful, intelligent, constructive public service. New commissioners have to become acquainted with the problems confronting them before they can do much in the way of solution. Few, if any, state officials have the opportunity that is before public service commissioners of acquiring a knowledge that may be definitely valuable after retirement from office. Their experience is a valuable training of whose benefits the community ought not to be deprived. If the public is so foolish as to let capable commissioners leave office, the corporations ought to be wise enough to seek the knowledge available in these trained men. Certainly the corporations need to adopt the fair-minded, balanced attitude which characterizes an impartial commission. We are not of those who think that a sharp line should be drawn between men who serve the public and men who serve the corporations and that a step from one side to the other is a step to destruction. There is no logical reason why an able, broad-minded man should not honestly and acceptably serve either one freely. By reason of his familiarity with the corporate side, he can better serve the public as its representative. Similarly, his experience as a public servant better fits him to be a corporation official. Until the public learns enough to keep good commissioners there will be frequent changes. One of the best public servants that New York State ever had was the first chairman of its Second District Commission. After his retirement Mr. Stevens became counsel for the New York Central & Hudson River Railroad, advising it on questions of valuation. That is a proper and conspicuous application of a practice which is to be warmly commended.

A Forum for Public Utilities

The meetings of the Finance Forum under the auspices of the Young Men's Christian Association in New York City are affording an excellent opportunity for the presentation of public utility issues. Constructive work of this kind will be necessary in other cities if the public is to learn more of the public utility side of present problems. Speakers at the various meetings have discussed many different subjects of importance to public utility industries. They have brought out facts which are not matters of common public knowledge but are matters of common discussion in the court and commission proceedings of the times. Officials of companies have said too little to the public in the past in regard to their problems. It is not too late to begin anew and every effort should be made to lead the public to feel that the problems of the companies concern consumers just as much as owners of the property. Because the task of meeting an uninformed public is not easy is no reason why it should be neglected. It is not reasonable to expect that an immediate public acceptance of a reasonable corporation point of view will follow a few meetings of this character. If the meetings held in New York do no more than to inspire similar gatherings in a number of leading cities of the country, they will have exercised a far-reaching influence, for which operators may well be thankful. The talk made at the meeting this week by Mr. Thomas N. McCarter, of the Public Service Corporation of New Jersey, an abstract of which is published elsewhere, is the

kind of frank discussion that will help the public to understand that there is a side different from the one presented by politicians. The corporate side is entitled to as fair a hearing as is the agitator's side.

The Richmond Hydroelectric Plant

From the standpoint of hydraulics, the plant described in this issue affords a lesson that will well repay study. It is a singularly good example of what modern methods and apparatus can do in making the best use of opportunities. Not only is the particular privilege utilized interesting as one of the earliest American developments, but until the reconstruction which resulted in the present modern equipment it was a conspicuous relic of methods now outworn. The old pumping station, in fact, contained probably the last considerable installation of overshot wheels in the country, and with its replacement the type practically passed out of existence. A change in the water-works system forced action, and the result was not only an up-to-date electrical pumping station adapted to the needs of a prosperous and growing city, but a municipal lighting plant adequate to its requirements. The present dam furnishes water for four directly coupled units aggregating 1700 kva. These drive six 200-hp motors which serve the new pumping plant. As the pumping is essentially a day load, the generating equipment can be utilized also for the lighting of the streets and municipal buildings. The street lighting, we may note, is on a considerable scale for a city the size of Richmond, comprising nearly 1300 arc and more than 1000 incandescent lamps, the latter being chiefly of the 100-watt size in clusters of five. It is worth noting that the underground circuits which feed energy mainly to 10-amp flame-arc lamps are tied in through the series transformers, which raise the main circuit current from 7.5 amp to 10 amp.

As water in the James River runs low in summer, it was necessary to provide an auxiliary steam equipment, which is in the highly effective form of a pair of 1000-kva turbo-generators with a suitable modern boiler plant. A somewhat unusual arrangement appears in the exciter equipment, which consists of a pair of 50-kw generators coupled to induction motors wound for the full primary emf of 4000 volts. These sets are accelerated from rest by a Pelton wheel, receiving water from the city mains, which furnish a pressure of 80 lb. per sq. in. When the excitation is brought to full voltage for the motors the driving belt of the motor is shifted. For the drainage of the engine-room level use is made of a receiving drainage tank, which is cleared by a pair of centrifugal pumps, a plan made necessary by the fact that when the river is at its high stages the engine-room floor is below water level.

As far as was possible the foundations and dressed granite walls of the old plant were used for the new, and by the exercise of considerable ingenuity practically only the boiler room and stack had to be of new construction. The electrical equipment is mainly of standard type, but it is worth mentioning that the generators are wound for three-phase, four-wire distribution, so that both 4000-volt and 2300-volt circuits are in use. As a whole, the Richmond plant represents an excellent example of skilful reconstruction to secure economy of cost and efficiency of operation and shows admirably what can be gained by taking full advantage of improved methods.

Meteorological Influences on Radio-Telegraphy

It is well known that atmospheric disturbances affect radio-telegraphic signals, and occasionally in a most markedly objectionable manner. The disturbances are of at least two kinds, namely, those due to electric discharges, or lightning, in the air, and those due to the influence of sunlight. The lightning disturbances may be most violent during a thunderstorm in the vicinity, when radio-telegraphic station operators may be compelled to ground their antennas and bring their signaling to a close. The lightning disturbances, on the other hand, may be so mild and remote as to produce only occasional feeble cracklings in the listener's telephone. All degrees of intermediate disturbance may exist. In the tropics, under the local great intensity of solar radiation, lightning disturbances are naturally intensified.

The effects of daylight do not become noticeable until the sending and receiving stations are separated by a distance of 100 km or more. At long distances the effects become very noticeable. The general effect is a comparative constancy of signal intensities during daylight hours, when both sending and receiving stations are in full daylight. At night, when both stations are in shadow, the signal intensities are usually much stronger than by day, although they are subject to considerable and occasionally to sudden changes. Moreover, pairs of distant stations on east-west lines are subject to marked fluctuations in signal intensity near the times of sunrise and sunset between them. The causes of the daylight effect seem to be associated with the ionizing influence of violet and ultra-violet solar rays in the upper regions of the atmosphere, and also possibly with a semi-permanent layer of ionized matter at a high level in the atmosphere, perhaps caught from the sun's expelled corona. During night time this hypothetical layer of electrified dust may serve as an inverted reflecting layer, or a concave ocean in the sky, to guide the electric waves forward without further expansion upward. During daylight hours ionization at lower levels would tend to destroy the beneficent action of this permanent layer.

At sunrise and sunset, as was first pointed out in this country, the layer of discontinuity between sunlight and shadow, or ionized and non-ionized air, may be supposed to have dispersing action to waves passing through it, and also feeble reflecting action; so that when this shadow boundary falls on one side or the other of a pair of east-west stations there is a temporary stimulus to the transmitted and received signals, in east to west

order, by partial reflection, with a marked diminution or weakening when the boundary strikes in between them. Much remains, however, to be investigated in these directions, although there can be little doubt that investigation will reveal facts of meteorological importance, as well as facts of importance in radio-telegraphy. The whole subject of meteorological influence on radio-telegraphy has been discussed in a recent article by Dr. Paul Ludewig in *Elektrotechnik und Maschinenbau*, as abstracted in this week's Digest.

The Universal Electric Vehicle

Arguments showing that there is a demand for an electric vehicle from which all unnecessary refinements in upholstery and other luxuries have been eliminated are well presented in letters by Messrs. H. G. Overbeck and H. H. Skinner on page 882 of this issue. In many respects these writers corroborate the statements made in a lecture before the Electric Vehicle Association of America by Dr. C. P. Steinmetz, who pictured the passing of the gasoline automobile and predicted the era of the electric vehicle. Taking for ourselves a rather more conservative viewpoint, we hesitate to join in with this prediction of easy conquest for the battery-propelled vehicle, for one must not forget that the gasoline-propelled competitors have a tremendous start in numbers, while in the way of conveniences they are rapidly adding details which leave only a narrow margin between the gas car and the electric. Capricious as it is intangible, custom yet has enormous inertia, and pure logic alone will not eliminate the lead secured by millions of dollars invested in the gas-car industry.

Always practical, Dr. Steinmetz did not leave his attractive picture of an all-electric future without first offering real constructive suggestions as to how the desired end shall be speeded. As the golden text of his address there stands out above everything else, we think, his pregnant proposal concerning early-morning off-peak charging for vehicles. During the hours of darkness after midnight the average central station could profitably charge the batteries of a fair number of passenger cars at an individual cost as low as even, perhaps, $5 per month. The operation would be under the supervision of expert batterymen, thereby insuring satisfaction to the customer. And, to the central station's benefit, this night load would conveniently fill the early-morning niche in the load curve when thousands of dollars' worth of equipment is standing idle. The ingenious system of identification cards suggested for noon boosting charges (coinciding, by the way, with that midday sag in the demand curve) reveals additional kindly solicitation for the interests of both the vehicle owner and the central station. Such interesting questions as whether the electric automobile is to sweep the field of self-propelled locomotion, or whether $600 will be adequate to buy a light battery car, as authorities both inside and outside of our own field have asserted, can be assigned by the central-station man for consideration at a future date.

Grounded Transmission Systems

The grounded star connection for transmission lines has been long acclaimed in theory but most frequently avoided in practice. The advantages gained under normal conditions are altogether obvious, but the ever-present chance of grounds on the lines has always been a cause of worry. On the whole, we think the danger has been somewhat overestimated, for prevention is much better than cure and in a moderately simple system a "ground" ought to be a rather remote contingency. Yet grounds in a system with grounded neutral may make serious trouble in the way of interruptions to service. It is the reduction of this particular danger that Mr. Max H. Collbohm discusses in an article in this issue. As grounded systems are generally arranged an additional ground on a line will open a circuit-breaker. The author suggests overcoming this difficulty by placing in the ground circuit a series transformer which puts the circuit-breakers out of action by breaking the tripping circuit and sounds an alarm for the purpose of giving the operator a chance to make use of a spare line or apply other remedial measures before the service is interrupted. Such conditions mean quick work, but even a few minutes saved at this stage may avert an interruption of service.

Another scheme mentioned by Mr. Collbohm is the protection of insulators against arcing over by the installation of arcing rods above and below to lead the arc away from the insulator as soon as it is formed. Modern insulators of either the suspension or the pin type, if well designed, will withstand much hard usage, and if an arc can be promptly removed from the insulator a mischievous ground may be prevented. Mr. Collbohm calls attention to a very good use for copper-clad wire as a protective conductor. Its tensile strength and fairly good conductivity as compared with the usual stranded steel are in its favor, and its inductance is moderate compared with that of steel having equivalent conductivity. This wire is mounted 10 ft. above the circuit wires, a height we are inclined to think is advantageous. At all events, the experience with these various safety precautions during the past season seems to have been very encouraging. To encounter some sixty hours of severe thunderstorms with only four seconds of interrupted service surely bespeaks good protection as well as good luck. The fact that no insulators were lost through lightning affords good evidence of the usefulness of the arcing rods. First and last, the grounded line seems to have operated as well as one could wish. It is worth noting that one of the advantages of tower construction with long spans is the comparative ease of applying protection at each point of support. It is an application of the advice ascribed to Carnegie to put all eggs in one basket and then watch that basket. Certainly the time has arrived when overhead transmission lines can be so built as to insure a degree of continuity of service that is very satisfactory. The price for this is thorough construction and constant vigilance.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

Convention of National Electrical Contractors' Association

The various committees of the National Electrical Contractors' Association are now actively at work in connection with the forthcoming convention of the association, which will be held in Detroit, Mich., July 14-18, inclusive. The convention headquarters will be at the Hotel Cadillac, and an elaborate and most entertaining program has been arranged for the week. One of the special events will be a steamboat trip on Lake Erie to historic Bois Blanc Island, 19 miles from Detroit. The visiting contractors will also be shown the chief industries of Detroit, which city leads the world in the manufacture of motor cars, automobile accessories and adding machines.

Electric Clearing House at Louisville

Desiring a more thorough and mutual understanding of the National Electrical Code and the local rules, the electrical contractors, inspectors and representatives of the Louisville lighting companies have effected an organization known as the Electric Clearing House of Louisville. Mr. C. C. Childers, of the Childers & Waters Company, is president; Mr. F. G. Burdorf, of the Burdorf & Brecker Company, vice-president, and Mr. E. C. Knopp, of the Kentucky Actuarial Bureau, secretary of the organization. Meetings will be held monthly and arrangements will be made for lectures and demonstrations of an instructive nature. All the devices and changes in rules will be brought before the meetings and fully explained. Informal talks and illustrated lectures by inspectors will also be features.

Electric Ranges for Worcester Apartment House

Electric cooking will be exclusively employed in a new eighteen-suite apartment house being built at Worcester, Mass., by the Colonial Real Estate Trust. The building will not contain a single foot of gas piping, and the only coal bin will be utilized by the central steam-heating boiler. In the face of a 75-cent gas rate and sharp competition by the local gas company, eighteen No. 33 electric ranges will be installed by the Simplex Electric Heating Company, of Cambridge, Mass., and energy will be supplied by the Worcester Electric Light Company at its regular heating rates, which are established on a sliding scale, starting at 10 cents per kw-hr. and working rapidly downward with increased consumption. The suites are of four and five rooms and are to be equipped with electric vacuum-cleaner service and a central motor-driven refrigerating plant. A master meter will probably be installed and energy distributed to the tenants by the landlord. At full load each range consumes about 4800 watts. The apartments are situated in the fashionable West Side district, and their equipment for electric cooking follows a thorough trial of a similar range for several months in the home of the builder. Much local interest has been aroused in the installation, and many inquiries are being received at the office of the central station as a result of the victory of the electric range over its competitors.

New Trust Legislation Bill

The text of the omnibus bill embodying the revised ideas of administration leaders in Congress in regard to trust legislation was made public in Washington by Representative Clayton on April 14. A new feature of the proposed legislation is the incorporation in the bill of provisions defining the status of labor unions under the law, limiting the power of the United States courts in the issue of injunctions and providing for jury trials in cases of indirect contempt of court. The bill is designed to take the place of four bills which have been under discussion by the judiciary committee of the House of Representatives.

The consolidated bill contains a modified section dealing with holding companies. The proposed restrictions regarding interlocking directorates have also been changed. New conditions governing price discrimination and competition are set forth.

The Washington Meeting of the A. I. E. E.

The American Institute of Electrical Engineers will hold a meeting at Washington, D. C., April 24 and 25, under the auspices of the electrophysics committee and with the co-operation of the American Physical Society. The headquarters will be in the Electrical Building, Bureau of Standards. The joint technical and scientific sessions of the meeting will be held in the new electrical laboratory of the bureau. A special attraction of the meeting will be the exhibit of apparatus which is being arranged by the American Physical Society in co-operation with the Bureau of Standards. There will be exhibits by manufacturers and importers and scientific and industrial research laboratories. A number of the federal scientific bureaus will also be represented.

On Friday morning there will be a joint meeting of the A. I. E. E. and the American Physical Society. For 1 p. m. a luncheon has been arranged in the West Laboratory, tendered by the scientific staff of the Bureau of Standards. Opportunity will be afforded to inspect the laboratories of the bureau and the special exhibit of lecture, laboratory and research apparatus under the auspices of the Physical Society. At 3.30 p. m. Sir Ernest Rutherford will lecture on "X-Ray and Gamma-Ray Spectra." At the joint evening session the following papers by members of the Institute will be presented: "Solenoids," by Mr. C. R. Underhill; "Some Investigation of Lightning Protection for Buildings," by Mr. L. A. DeBlois, and "Some Simple Examples of Transmission-Line Surges," by Prof. W. S. Franklin. Following this session a buffet smoker will be tendered

by the Baltimore and Washington Sections of the A. I. E. E. to the members of the American Physical Society, the members and guests of the Bureau of Standards, and the visiting members of the Institute.

The joint meeting on Saturday morning will be conducted by the Physical Society. The program includes two Institute papers, "A Milliampere Current Transformer," by Prof. Edward Bennett, and "Theory of the Corona," by Mr. Bergen Davis. The afternoon will be devoted to visiting points of interest in Washington.

Municipal Street-Lighting Plant Idea Scored at Springfield, Mass.

In connection with the purchase of 1500 acres by the city of Springfield, Mass., last week on the Little River watershed to augment the local water supply, a plan to develop a hydroelectric plant for municipal street lighting has received considerable discussion. Prof. Harry E. Clifford, of Harvard University, street-lighting expert of the municipality, was asked to give his opinion of the proposed municipal-plant scheme a few days ago, and in forcible terms he said that the city would do far better to make a new contract with the United Electric Lighting Company than to enter upon the unprofitable task of attempting to generate and transmit its own energy in competition with the efficient local central-station system. Professor Clifford said that it would cost the city at least $3,000,000 to build underground ducts and install the necessary street-lighting cables, and further said that municipal operation would be unsuccessful if applied to the lighting and motor service of the famous "Municipal Group" of public buildings on Court Square. Attempts have been made within the past two or three months to establish an isolated plant for this service. In analyzing the bids, Professor Clifford pointed out that no allowance had been made for auxiliary machinery and that the present boiler equipment is insufficient for electric requirements.

Electrochemical Possibilities of St. Louis

Several out-of-town visitors attended the weekly luncheon of the St. Louis League of Electrical Interests, Jovian Chapter, at the American Hotel Annex on April 14. A special meeting of the Missouri Electric, Gas, Street Railway and Water-Works Association was held during the morning, and the Union Electric Light & Power Company entertained a party of twenty-five at the luncheon. Mr. Walter O. Pennell, equipment engineer of the Southwestern Bell Telephone System, presided, and Mr. Courtland F. Carrier, Jr., of Lawrence & Carrier, Inc., consulting chemical engineers, read a paper on the "Possibilities of St. Louis as a Field for Electrochemistry." Mr. Carrier spoke of the close relation of chemistry and electricity. In St. Louis there is already one plant for the electrical production of hydrogen and oxygen, and another will soon be established. An electric steel furnace will soon be put into operation in St. Louis. The speaker thinks that St. Louis has a good opportunity to build up electrochemical industries. Chemical industries in the United States pay 70 per cent higher dividends than other industries. In Germany an average of forty chemical industries show 14 per cent dividends. Speaking of the Niagara Falls situation, Mr. Carrier said that the rates for electrical energy are rather higher in Buffalo than in St. Louis. Right at the Falls the rates are a little lower. Electrochemical plants are desirable. A good one should be able to maintain an 85 per cent load-factor. Single electrochemical industries take as much as 40,000 kw. Consumption of energy in the electric furnace for making steel ranges from 200 kw-hr. to 800 kw-hr. per ton. After a time the tendency of prices for electrical energy, now going down, will go upward. St. Louis, with cheap energy and near the raw materials of many products, is favorably situated for the location of electrochemical industries. Mr. Philip J. Kealy, of the Kansas City Railway & Light Company, was called on. He said that Kansas City is rapidly developing as an electrical center. The revenue of his company has more than doubled in the last four years.

Mr. McCall on Pennsylvania Commission

Mr. Joseph B. McCall, president of the Philadelphia Electric Company, refers, in his annual report to stockholders, to the public service company law enacted at the last session of the Pennsylvania Legislature. Mr. McCall says that the commission has broad powers and the Pennsylvania companies controlled by the Philadelphia Electric Company will come under its control. He adds: "Your management feels there will be no serious difficulties in your companies operating under this regulating act and that an equitable and reasonable interpretation of it will result in benefit."

Mr. McCall also refers to the contract made with the Pennsylvania Railroad Company during the year, under which the Philadelphia Electric Company will supply all the electrical energy for the section of the road between Philadelphia and Paoli, which is now being electrified, and such additional energy as from time to time may be necessary for the electrical requirements of the railroad. The contract is for a period of five years with a minimum guarantee of 3750 kw. Contracts of this character made with other public service corporations, Mr. McCall adds, demonstrate the growing tendency to the use of one central source of supply in large communities.

The membership of the Philadelphia Electrical Beneficial Association is 2191, or 87 per cent of the total of 2502 employees. The receipts to Dec. 31, 1913, were $206,503. Disbursements were as follows: Disability benefits, $97,290; death benefits, $62,550; medical expenses, $12,691; total, $172,531. The balance in cash and securities at the end of the year was $33,972.

Missouri Association Adopts Reports of Committees on Accounting System

At the adjourned meeting of the Missouri Electric, Gas, Street Railway and Water Works Association, held on April 14, in the assembly room of the Union Electric Light & Power Company of St. Louis, reports of committees on the proposed uniform system of accounts of the Missouri Public Service Commission were presented. Mr. A. C. Einstein, vice-president of the Union Electric Light & Power Company, occupied the chair as acting president of the association. Mr. F. D. Beardslee, St. Louis, acted as secretary. Among those in attendance were representatives of the Doherty, North American, Insull and McKinley interests.

Mr. H. Spoehrer, secretary and treasurer of the Union Electric Light & Power Company, told of an interview with the members of the commission, who stated that they were glad to have the views of the association in regard to the classification of accounts. Mr. Philip J. Kealy, Kansas City Railway & Light Company, chairman of the committee on depreciation, presented the report of that committee. Taking up the

proposed deduction of depreciation reserve from fixed capital account, the committee recommended that the commission be petitioned to consider the depreciation reserve as a reserve account. The committee set forth objections to the plan to consider the depreciation reserve as a fund. The report asked that the committee be continued, as further light will be needed concerning the exact meaning of the definitions of the commission. After a brief discussion the report was adopted unanimously.

Mr. Hugo Wurdack, Light & Development Company, St. Louis, reported as chairman of the committee appointed to consider the tentative requirements of the commission in relation to historical data. The committee said that the expense of keeping this information in the manner requested by the commission would be prohibitive. It believes that the proposal in its entirety is wholly impracticable. It is difficult to see how much of the information requested will be of value. A company should not be required, the committee declared, to meet the expense necessary to furnish most of the information shown on the tentative schedule. This report was also adopted unanimously.

Mr. Edwin Gruhl, Electric Company of Missouri, St. Louis, reported as chairman of the committee on the classification of accounts as applied to small companies and on the construction of the classification as applied to large companies. This report went into the matter in detail, pointing out the difficulty of complying with the requirements of the tentative classification. Some substantial items have been omitted from the classification. One is the cost of complying with the requirements of the commission. In the discussion on this report, Mr. Wurdack said that the law creating the Missouri commission provides that the company may keep any account it desires provided the books are always open to the inspection of the commission. Mr. R. C. Russum, Joplin, Mo., said he doubted if this interpretation of the law is correct. Mr. Gruhl said that many of the requirements of the tentative system are very drastic for small companies.

It was suggested that a company whose gross earnings are less than $25,000 be considered a small company under the classification. The report of the committee was adopted unanimously.

Votes were taken thanking the committees for their work. Some discussion ensued on the procedure to be followed in filing protests with the commission in legal form if such protests are thought to be necessary. A number of those who attended the meeting left St. Louis on the evening of April 14 for Jefferson City in order to attend the formal hearing on the proposed system of accounts before the commission beginning April 15.

At the hearing before the commission at Jefferson City on April 15, after a discussion lasting several hours, a committee of twelve was appointed headed by Mr. Philip J. Kealy. This committee will confer with Chief Accountant McShane of the commission in regard to modifications of the classification. The committee will report after May 15.

The Electric Vehicle at Boston

At a regular meeting of the Electric Motor Club of Boston on April 8 plans were discussed for holding a tent exhibition of electric passenger cars and trucks in various New England cities in the late spring, and the co-operation of several central stations was manifested in regard to the securing of sites and supplying of garaging facilities. It is planned to exhibit as many of the seventeen representative makes having agencies in New England as can be induced to join in the enterprise, the Boston Edison Company providing the tent, which will be illuminated by fifteen 500-watt tungsten lamps. In addition to cars and trucks there will be an exhibit of rectifiers, batteries, tires and other equipment of direct interest to the electric-vehicle owner.

Mr. C. H. Miles, Boston, stated that quotations have been received from one of the foremost map-publishing houses in New England for printing a map showing the location of charging stations and the automobile routes in this section of the country. The concern is ready to supply 5000 copies at 10 cents each or 10,000 copies for about 7 cents each. Mr. R. S. Hale, of the Boston Edison company, called attention to the adoption in England of the 150-amp charging plug recently standardized by the Electric Vehicle Association of America and exhibited samples of cab-tire sheathing for charging cables, emphasizing the demonstrated value of this material abroad as a tough, acid-proof and alkali-proof wire covering, and urging its production by American manufacturers. Other matters briefly discussed were plans for the annual outing of the club and for an electric-vehicle convention to be held in Boston about the middle of May.

New York Meeting of the Illuminating Engineering Society

Papers were read before the New York Section of the Illuminating Engineering Society on April 9 by Mr. M. Luckiesh, of the National Electric Lamp Association's physical laboratory, Cleveland, Ohio, on "Glassware for Protecting the Eyes in Industrial Processes"; by Mr. R. E. Simpson, engineer for the Travelers' Insurance Company, Hartford, Conn., on "Illumination as a Factor of Safety in Industrial Plants," and by Dr. William Churchill, on "Some Reasons Why Red Is Not a Proper Color for Danger Signals."

Mr. Luckiesh stated that certain special uses of illumination and certain industrial processes require light rich in ultra-violet radiation, and in these cases protection of the eyes by some transparent glass medium is demanded. Such protection is accomplished by glasses which do not transmit the ultra-violet energy and which also reduce the retinal image to a safe brightness. Colorless or neutral glasses are to be preferred, but no glasses of this character have been found to be wholly satisfactory. As a general solution of the problem of eye protection it is proposed that a yellow-green glass totally absorbing ultra-violet be combined with a shade of smoke glass of such density as to reduce the brightness to a safe degree. Transmission curves of several characteristic glasses were shown. Spectrograms of the light from a quartz-tube mercury arc and from an iron arc have been made through many samples of glass. For many cases such spectrograms provide sufficient data for analyzing the absorbing property of the glass.

As no neutral-tint glass was found which totally absorbed the ultra-violet, a yellow-green glass was chosen as most desirable for several reasons. It was found that workmen in welding processes preferred this color to any other. They successfully used this at once, while condemning amber glasses. Colors are distorted less through this glass than through glass of any other color. Another significant fact is that the relation of the temperature and luminosity for black or gray bodies is practically the same through a yellow-green glass as to the unobstructed eye.

In the discussion following the reading of Mr. Luckiesh's paper, Dr. Churchill called attention to the necessity of putting the use of the different colored glasses

on a scientific basis and of standardizing the various kinds of glasses so that a person can be reasonably sure of getting what he asks for.

In his paper on illumination in factories, Mr. Simpson showed that many accidents in industrial plants can be avoided by providing proper illumination. Many of the mishaps, he declared, are due to employees falling in poorly lighted passageways. In ship-building particularly, open hatches, incomplete stairways and dark gangways furnish hazards that can be materially lessened by means of good lighting. The author also dwelt upon the use of reflectors and the avoidance of glare in the workmen's eyes.

For normal vision red is the most effective color of warning, Dr. Churchill asserted, and in railroad engineering where rigid examinations are made to eliminate employees afflicted with color blindness this cardinal color lends itself very well to signal work. Owing to the increasing use of red, however, as a warning of danger in other fields, and on account of the belief that 4 per cent of males and 1 per cent of females are color blind, the possibilities of accidents are increased. In the operation of automobiles, for instance, red taillamps are used. It is safe to conclude that 4 per cent of the chauffeurs are color blind. As these chauffeurs are not subjected to examinations for eyesight, the risks on account of misinterpretation of signals are manifold. It would be better and safer, the author declared, to adopt some other color which most people would be able to recognize as a signal of danger.

Committee of United States Chamber of Commerce on Trust Legislation

The Chamber of Commerce of the United States is holding a referendum on the proposed Interstate Trade Commission. Those who are voting are 543 commercial organizations in forty-seven states. The referendum is on the report of the following special committee: Messrs. Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, New York; William L. Saunders, president of the Ingersoll-Rand Company, New York; Charles R. Van Hise, president of the University of Wisconsin; Henry R. Seager, Columbia University; Charles F. Mathewson, attorney, of Krauthoff, Harmon & Mathewson, New York, and George Rublee, of Washington, formerly member of the firm of Spooner & Cotton, New York. Mr. R. G. Rhett, president of the People's Bank, Charleston, S. C., acted as chairman of the committee.

The definite recommendations placed before members of the Chamber of Commerce are as follows:

"1. That there be created an interstate trade commission of at least five members appointed by the President and confirmed by the Senate, not more than a mere majority of whom shall be of the same political party.

"2. That jurisdiction of the commission in conducting investigation extend to all corporations engaged in interstate or foreign commerce, except such as are amenable to the Interstate Commerce Commission. (It has not been judicially determined whether or not banks are engaged in interstate commerce, but it is not understood to be the purpose of the bill creating an interstate trade commission to include banks among the corporations placed within the judisdiction of the commission.)

"3. That the commission should not now be given authority to advise applicants concerning the legality of proposed contracts, combinations, etc., under the Sherman act.

"4. That the annual reports of corporations, if required, should at the outset be confined to those of the larger corporations (say, to those having capital resources of $5,000,000 or more, or to those having an annual income of $2,500,000), and to such other classes of corporations as the commission may officially determine.

"5. That in the annual reports made to the commission corporations ought not to be required to disclose trade processes, shop costs, classification of sales and profits among particular articles, names of customers or other like private information.

"6. That the publication of facts obtained by the commission be confined to such as are to the public interest.

"7. That Congress should direct the commission to investigate and report to Congress at the earliest practicable date on the advisability of amending the Sherman act to allow a greater degree of co-operation in the conduct, and for the protection, of the foreign trade."

The committee declares that neither size nor any other arbitrary standard of classification is a sure criterion of lawfulness or unlawfulness under the anti-trust act or under any other law.

It is expected that the committee will hold further meetings and make a separate report on other features of the proposed legislation.

Business Conditions in California

Business conditions in California are discussed in detail in the annual report issued to stockholders by the Southern California Edison Company. Mr. John B. Miller, the president, refers to the estimate of gross earnings which he made at the annual meeting in February, 1913. At the time he estimated that gross earnings in 1913 would be $5,000,000. The actual amount was $4,779,279. Instead of his estimated amount of $2,500,000 for operating expenses, including taxes, insurance and maintenance, but exclusive of depreciation, the actual amount was $2,430,290. The net earnings as estimated were $2,500,000, but the actual amount was $2,348,989. Interest and amortization were estimated at $820,000, but the actual charge was $813,969. Instead of the estimated surplus of $1,680,000, the actual surplus was $1,535,020.

Undisturbed by this showing, Mr. Miller makes a new estimate for 1914. Based upon ability to finance expenditures for new business and upon normal conditions, he estimates that gross earnings will be $5,250,000 or will exceed that amount. To reach that amount would mean an increase of 9.8 per cent. He estimates the surplus applicable to dividends and depreciation at $1,775,000. The report says that financial conditions not only in the United States but throughout the world became so unfavorable shortly after the first of the year that, commencing in April, the directors thought it the part of wisdom to restrict expenditures for all purposes, including new business, to the lowest point consistent with safety and due regard for the company's duty to the public. Had it not been for this, Mr. Miller says, the estimate would not only have been realized but probably somewhat exceeded. Under the conditions the showing made should be gratifying, he adds. While the company has recently raised its dividend rates to stockholders, it has also lowered rates to customers all over the system, which shows the strongly intrenched position the company occupies.

During the winter just ended Southern California was visited with two of the heaviest rains that have been known in many years, in January and February,

1914. All public utilities were out of commission because of floods and washouts and the total damage will amount to several million dollars. Mr. Miller declares that this is more than compensated for, however, by the benefit of the abundant rains assuring the water supply for several years and, so far as the company is concerned, abundance of water for generating cheap power. The Southern California Edison Company went through the first storm with less than $5,000 loss and practically no interruption in service. The intervals between the storms, however, were too short to permit strengthening all the places weakened by the first storm, and in the second storm, while practically no injury to power plants was experienced, a great deal of damage to transmission lines took place. Notwithstanding this, there was no serious interruption to business, and with the exception of one small district in the San Fernando Valley the company was able to carry all of its consumers.

Mr. W. A. Brackenridge, vice-president and general manager, says in the report that it is probable that during the present year an amendment to the State constitution giving the Railroad Commission jurisdiction with respect to regulation of rates of public utilities within incorporated cities will be placed before the electorate. The present power of the commission regarding regulation of rates is limited to territory outside of incorporated municipalities except in a few instances where municipalities by authority of the present law voted to transfer such powers to the Railroad Commission.

Mr. S. M. Kennedy, general agent, says in a letter included in the report that under the assumption that financial conditions will very shortly become normal the prospects for additional business during 1914 are unusually good, as many projected enterprises have been held back which will be pushed to a conclusion as soon as the opportunity occurs and funds are made available.

President Wilson Wants Trust Legislation Pushed

Coincident with persistent reports that an effort will be made among democratic leaders in Congress to shelve the proposed anti-trust legislation for the remainder of this session, President Wilson early in the present week called Representative Clayton, chairman of the House judiciary committee, to the White House for a conference on the subject and agreed with him that an omnibus bill should be brought in from the House committee, as is to be done by the Senate committee on interstate commerce.

The President made it clear to callers at the White House that he believes the canal tolls repeal bill, rural credits legislation and anti-trust legislation can all be disposed of by Congress before adjournment. Whether he will have cause to change his mind remains to be seen, in view of a belief which is said to be growing in Washington that it would be the course of political wisdom to adjourn Congress without attempting anti-trust legislation. This belief has been strengthened since it became known that it was proposed to add to the omnibus trust legislation bill in the House a provision for the regulation of injunctions in labor cases, for it is said in Washington that if a question in which labor is vitally interested is added to the anti-trust legislation program much additional time for consideration and discussion will be required. Some of the Democratic leaders do not believe as much can be done before Congress adjourns as President Wilson believes. All their thoughts center upon the campaign for the House of Representatives this fall, and they say they will require time at home. They say that one of the necessities of a successful campaign is that business conditions shall not be disturbed, and that if anti-trust legislation is rushed through business conditions will be upset for awhile.

The Senate committee is still working on its proposed omnibus bill. Senator Newlands, chairman of the committee, expects to report it before the canal tolls repeal bill is disposed of and believes that it will be taken up as soon as that matter is out of the way.

Operating Under Difficulties in Mexico

The civil war now going on in Mexico has made it necessary for all large industrial companies to adopt means to safeguard their property. Armed guards are therefore established to resist not the attacks of the contending forces, but the incursions of marauding bandits who take advantage of the chaotic conditions at present existing in Mexico and commit depredations on private property. The electric-lighting companies among others have found it necessary to adopt defensive means, and an insight into the conditions existing is afforded in the case of the Mexican Light & Power Company, which operates the largest hydroelectric station in Mexico at Necaxa, about 125 miles from the city of Mexico. The plant has an effective head of about 1400 ft. and develops over 50,000 kw, which is transmitted to the city of Mexico. The equipment comprises two 10,000-kw General Electric machines and six 5000-kw Siemens-Schuckert machines, all operated in parallel and feeding into four transmission lines of stranded copper cables on pin insulators. The lines are tied together at Necaxa and Mexico City, so that in case of trouble any line may be disconnected. The generators, which are wound for 4400 volts, three-phase, and operate at a frequency of fifty cycles, are vertical machines directly connected to impulse wheels built by Escher, Wyss & Company, and controlled by governors of the same make. Oil-insulated, water-cooled General Electric transformers step up the potential to 88,000 volts.

Trouble was at first encountered at night because of miscreants within the station who sympathized with the rebels tripping out the exciter circuit-breakers and tampering with important switches. Cement dust was sprinkled on the concrete floor for the purpose of discovering whether the culprits wore shoes, the sandals of the peon, or were bare-footed. Doors were also locked in order to protect certain apparatus. By this means a Mexican oil and rebel sympathizer was apprehended. A powerful 30-in. projector fed with direct current from a motor-generator set is used at night to sweep the surrounding country in search of rebels and bandits. One night the generator of the motor-generator set used for the searchlamp was discovered wrecked, and dirt was found in the bearings. This was done by some sympathizer, in order to hide the movement of a number of Zapatistas six miles off. By prompt work and not very elaborate repairing the projector was placed in service again that night, and an electrician was placed in charge of it. Part of the operating force was also sent out on guard duty in anticipation of an attack which fortunately did not take place. Every one in the power house is armed with a Mauser rifle furnished by the company.

Not long after the above incident a man was shot, and it was determined to run a line down to the likeliest place of trouble and light up the trail by means of four 60-watt tungsten lamps controlled by a switch at the sentry box overlooking the trail. An enameled wash-pan

was placed behind the lamps to serve as a reflector and keep in darkness the background where the armed operators were stationed. Another of these home-made bull's-eye lanterns was placed on a different trail, and when seven or eight weeks later there was a little fuss in the locality these lanterns became very useful. Two prisoners were taken alive, and a third was shot. Sta-

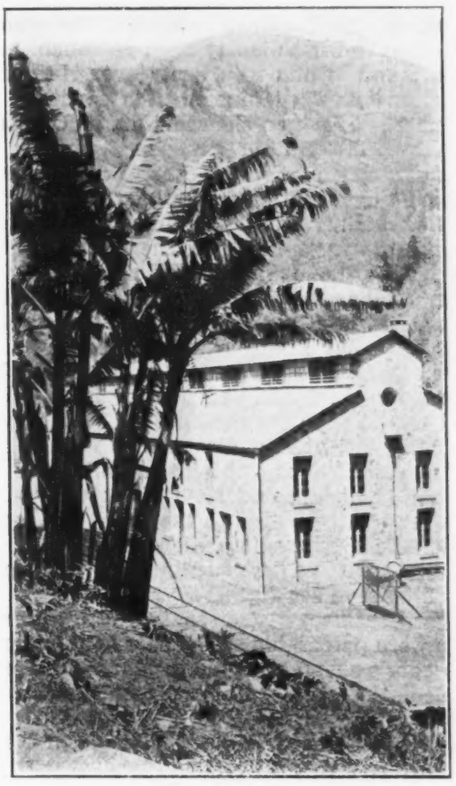


FIG. 1—POWER STATION AT NECAXA

tion operators were able to track him by blood marks to where he left the trail in the dark and evidently plunged headlong to his death in the canyon below, for two days later buzzards flocked to the spot.

Of course, it is necessary to protect the power station, although it is situated in a rather inaccessible canyon, since the city of Mexico depends upon it for

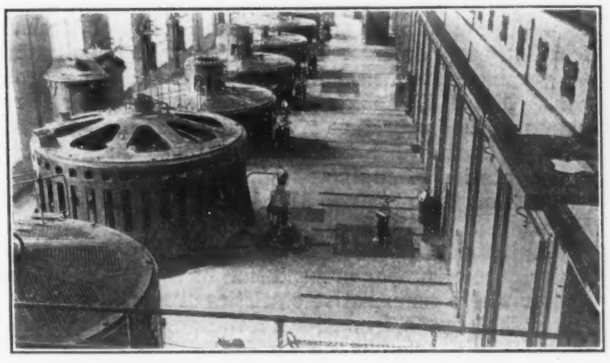


FIG. 2—GENERATOR ROOM, NECAXA STATION

transmitted energy for public and private lighting and for railway purposes. From five to eighty-five soldiers are quartered at the station at various times. Some of these are good men, some scoundrels, and others absolutely worthless. There are also a Hotchkiss rapid-fire field gun and three Colt machine guns available at the station in case of attack. Strange as it may seem, the transmission lines are not tampered with very much. The rebels at first climbed the steel towers and cut the lines with machetes, but inasmuch as this resulted in a 88,000-volt arc and a dead rebel, and was not very helpful to the cause, these pranks were short-lived. The rebels then began shooting at insulators. One night all four lines were shot down almost simul-

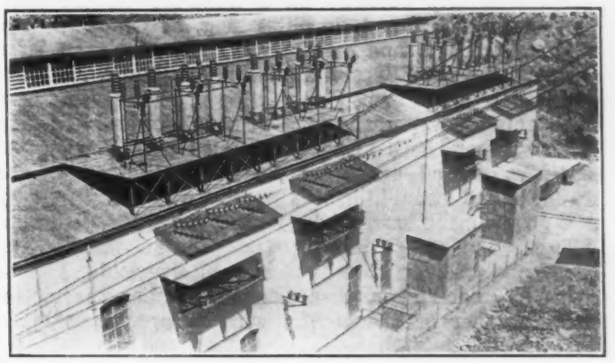


FIG. 3—OUTGOING LINES TO MEXICO CITY

taneously, as well as the telephone lines strung on the transmission towers. However, there was a telephone line on wooden poles some distance from the transmission line but parallel to it which was fortunately overlooked, and over this communication was had with Mexico City. This trouble occurred during a New Year's celebration and left the theaters, streets and

FIG. 4—NARROW-GAGE ROAD LEADING FROM STATION

dance halls in darkness, also tying up the railways until a small steam plant in Mexico City could be started. No rioting occurred in the city, and the President himself telephoned to the plant at Necaxa to ascertain whether or not it had been taken by rebels. Next morning soldiers were started from the plant and also from Mexico City, traveling toward each other. This

was the only time in which all four lines went down at once, and the lines since then have been constantly patrolled, so that trouble from this source has been almost entirely eliminated.

Needless to state, because of the presence of rebels or bandits in the vicinity the station operators do not stray far from the station. Two men were out on an inspection trip recently on a hand-car on the little narrow-gage railroad, 25 miles long, by which the station is reached, and on the way back were met at a turn in the road by six bandits. One had a rifle, but the others were armed only with machetes. The car was going down grade, and although ordered to stop the two men, both armed, continued on. One or two shots were fired, and a peon said later that one of the bandits had been killed. Bandits, when captured by the government troops, are in most cases executed by a firing squad of five men in charge of an officer. The usual and official custom is to have all five soldiers shoot with ball cartridges, then the officer stabs the victim with a saber or shoots him with a revolver to make certain of his death.

There are no wagon roads in the vicinity of the generating station, so that no wheel vehicles are to be found anywhere about the plant. The site is almost impregnable. All transportation except that by the private narrow-gage road owned by the company is by human beings or animals. Indians carry enormous loads on their backs, supported by a band passing over the forehead, and Mexicans are expert in loading pack mules.

Decision on Suspension-Insulator Patent

Much interest is attached to a decision rendered by Judge C. J. Lacombe, of the United States Circuit Court of Appeals, in a suit brought by the General Electric Company and Mr. Edward M. Hewlett against Mr. Louis Steinberger. The suit related to the disk-strain-insulator patent issued to Steinberger on Nov. 17, 1908, upon an application filed Jan. 20, 1908, which covered substantially the same type of insulator for which a patent application was filed by Hewlett on April 20, 1907. Having discovered its error in overlooking the prior Hewlett application, the Patent Office on Nov. 2, 1911, declared interference between Hewlett and certain claims of the Steinberger patent.

The invention in question consisted of a disk strain insulator comprising suspension members partially enveloped by a mass of insulating material and having a disk portion provided with annular collars or flanges extending in opposite directions therefrom and generally parallel with the suspension members. On April 29, 1912, the examiners in chief upheld the decision of the examiner of interferences, but the first assistant commissioner reversed the findings in a decision dated Aug. 6, 1912. On April 26, 1913, the Court of Appeals of the District of Columbia upheld Steinberger's priority. Subsequent proceedings were then instituted by the General Electric Company in the United States District Court for the Eastern Division of New York, before Judge Chatfield, in Brooklyn, the complainants availing themselves of a right granted in Section 4915 of the United States Revised Statutes.

Judge Chatfield rendered a decision on Oct. 9, 1913, reversing the award to Steinberger and declaring Hewlett the prior inventor. Supplementary opinions were filed on Oct. 18 and 21. The District Court held that the patentable invention lay in the use of annular flanges, which would accomplish water-shedding and insulating area-protecting purposes, under the conditions described in the drawings and specifications.

In the decision rendered by Judge Lacombe for the United States Circuit Court of Appeals, attention was called to the fact that upon the hearing of the interference Steinberger took testimony to show that he conceived the invention and made sketches about March or April, 1904. He did not, however, reduce his invention to practice until he filed his application in 1908. Judge Lacombe expressed the opinion that Steinberger did not display such reasonable diligence as would entitle him to priority over Hewlett, whose application was filed nine months earlier.

Steinberger further showed that in October, 1905, he wrote to Mr. Harold W. Buck disclosing an insulator and inclosing a sketch thereof. This, he alleged, embodied the invention in interference, and he contended that Buck had communicated it to Hewlett. Hewlett's attorney, being of the opinion that Steinberger's letter and sketch did not embody the invention, took no testimony on behalf of Hewlett. The examiner of interferences held that the letter and sketch were not a disclosure of the invention and awarded priority to Hewlett. On appeal the board of examiners-in-chief affirmed this decision. The next appeal was to the Commissioner of Patents, who held that there had been a disclosure to Buck and that upon the record as it stood it was to be inferred that Buck had communicated such disclosure to Hewlett. The latter then appealed to the Court of Appeals for the District of Columbia, which affirmed the Commissioner of Patents. Thereupon this suit was begun, with the result above set forth.

Judge Lacombe stated that while rain-shedding flanges were patentable at the date of the application, Steinberger's sketches, made in March or April, 1904, did not disclose the arrangement shown in his application filed on Jan. 20, 1908, and affirmed the decree of the District Court, Eastern Division of New York, giving priority to Hewlett.

A petition has been submitted to the Supreme Court of the United States, asking that the evidence be reviewed, and a motion has been filed requesting Judge Lacombe not to hand down his decree to the lower court until the Supreme Court has acted in the matter.

Graphic Statistics for Engineers Discussed

On the evening of April 14 there was given at the New York meeting of the American Society of Mechanical Engineers an interesting lecture on the application of graphical statistical methods to engineering problems. Mr. H. R. Cobleigh presided, and after brief remarks on the importance of the subject and the growing need for standardization of the methods for graphical representation of engineering statistics, introduced the speaker of the evening, Mr. W. C. Brinton, of New York.

The lecturer opened with an explanation of the large importance of proper presentation of reports and other matter where comparative statistics are dealt with. He stated that very often, after a large sum has been spent in collecting facts for such reports, their whole value is lost because of the poor manner in which they are presented for the consideration of the deciding parties. He stated that the reason why the engineer is often—in fact, generally—subordinated to the lawyer in the preparation of public reports is that the lawyer is better trained in expressing facts in a way that the public can understand. As a remedy for this undesirable state of affairs, he advocated a co-operative movement by all classes of engineering interests toward the provi-

sion of a standard method for the graphical presentation of engineering statistics. His lecture showed a number of illustrations of methods, bad and good, now in use for that purpose, as well as for other work along the lines of biology and government census. Along with the illustrations he gave some of the fundamental principles that have become partially standard practice and that help to make graphical presentation clearer.

Pittsburgh Meeting of A. I. E. E.

A meeting of the American Institute of Electrical Engineers was held in the Fort Pitt Hotel, Pittsburgh, April 9 and 10, under the auspices of the committee on the use of electricity in mines and the Pittsburgh Section of the A. I. E. E.

At the opening session Mr. Wilfred Sykes, chairman of the committee on use of electricity in mines, made a short address, which was followed by a paper on "Mine Duty Controllers," by Mr. H. P. Reed, of Milwaukee. The paper at the afternoon session was prepared by Mr. H. O. Swoboda, of Pittsburgh, and dealt with self-contained portable electric mine lamps. On the evening of April 9 there was an informal Dutch dinner at the Fort Pitt Hotel, at which Prof. C. F. Scott, past-president of the A. I. E. E., spoke on the growth of the electrical industry. At the session on April 10 the following papers were presented: "The Development of the Electric Mine Locomotive," by Mr. G. Eaton, of East Pittsburgh; "Construction and Operation of Mine Substations," by Mr. H. Booker, of Pittsburgh, and "Motor-Generator Sets Versus Synchronous Converters," by Mr. W. M. Hoen, of East Pittsburgh. Abstracts of all of the foregoing papers with the discussion elicited theron will appear in a subsequent issue.

Mine Regulations

Mine regulations for electrical installations containing German, English and American mining congress rules and Bureau of Standards and Pennsylvania state regulations were discussed on both Thursday and Friday afternoons.

Mr. Clark, in discussing the rules, said that they should help and not hinder, should preferably be divided under five headings, and should properly define ambiguous terms.

It was recommended that the divisions occupy the amount of space indicated in the following: General list of definitions, 10 per cent; character of equipment, 20 per cent; installation, 30 per cent; operation and maintenance, 15 per cent; inspection, 20 per cent; miscellaneous, 5 per cent.

Mr. C. W. Beers suggested that signs of warning printed in several languages be placed on electrical apparatus throughout every mine. The speaker was of the opinion that 250-volt distribution has no advantages over the 500-volt as regards safety and that the higher-voltage system has no advantages over the lower-voltage for maintenance. Alternating current was recommended for fairly high-voltage motors, provided that the primary windings are stationary. Impregnated windings and flexible couplings were considered desirable for increasing the reliability of high-voltage electrical apparatus. In addition, it was recommended that all framework be grounded. Mines should be divided into gaseous and non-gaseous sections, and rules governing work in these divisions should be general and should conform with A. I. E. E. standards.

Mr. E. M. Hewlett, Schenectady, N. Y., suggested that switchboards be designed so that if a person comes into accidental contact with a "live" conductor it will be impossible for him to fall against it after the shock.

Mr. J. P. Clayton, Mattoon, Ill., called attention to the Illinois law limiting mine-trolley voltages to 275 volts. He predicted that alternating-current mine equipment will be employed almost exclusively in the future to eliminate converting apparatus. Alternating-current coal-cutting apparatus, with which the speaker has had experience, has cost less to operate than the direct-current type and is more satisfactory mechanically.

It appeared to be the opinion of those present that cables should be armored to prevent danger from accidental contact with miners' picks and tools of a similar nature.

Mr. C. M. Means, Punxsutawney, Pa., considered the existing bituminous coal code to be unsatisfactory and suggested that a new code be drawn up along the lines of the Underwriters' rules. In discussing the diagrammatic representation of electrical installations it was suggested that symbols be employed rather than a color scheme so that it will be possible to reproduce the plans on a blueprint.

Mr. J. S. O'Donovan, Sharpsburg, Pa., suggested painting high-voltage lines in different colors to indicate the potential at which they operate.

Mr. Beers spoke of a Polish school for instructing miners how to care for a person who has received an electric shock.

Mr. Thomas said that the permissible voltage to use in mines depends entirely on the conditions of operation. Too many danger signs are about as bad as too few because they lose their effectiveness.

Mr. A. S. Biesecker, Scranton, Pa., said that in anthracite regions the corrosion of cables by acid had been eliminated by covering them with jute. Several hundred alternating-current coal cutters have been installed in the same region, but none is being operated now, as they proved unsatisfactory.

Chairman Dudley called attention to the difference between the voltage of a direct-current system and that of an alternating-current circuit having the same effective value when considering the effect of a shock from alternating current.

Mr. Newton discussed the subject of bonding, saying that the compressed terminal bond is the best and that there is no reliable method of making a temporary bond.

Mr. A. F. Nesbitt, University of Pittsburgh, commended the Bureau of Mines for its work and urged the A. I. E. E. to help young student engineers by placing all available information in their hands.

Mr. C. G. Braehm, Uniontown, Pa., suggested that electrical inspectors be employed to enforce rules in mines.

Mr. Means brought out the fact that inspection often works a hardship on the small mine operator, since the average profit is only 2 cents or 3 cents per ton at the most and an additional cent for inspection would lower the profit still more. Several steel-mill engineers emphasized the advantage of inspection, saying it often costs more than repairs but is worth the expense.

On the subject of portable apparatus Mr. Bright remarked that it was formerly bought by purchasing agents without attention to its application, but conditions are now different and more satisfactory.

Mr. Bright suggested that lamps be placed at all crossovers and in wall-pockets. Pump and fan installations should also be well illuminated.

Mr. Thomas recalled a suggestion to place lamps in multiple so as to prevent darkness in case one burns out.

The meeting adjourned Friday afternoon. Saturday was devoted to an inspection of the industrial plants of the Pittsburgh district.

Mr. McCarter on the Future of Public Utilities

At the meeting of the Finance Forum of the Young Men's Christian Association in New York on April 13 the subject was "The Future of Public Utilities," and the speaker was Mr. Thomas N. McCarter, president of the Public Service Corporation of New Jersey. Mr. O. B. Willcox, of W. P. Bonbright & Company, Inc., New York, introduced the speaker, after a very brief talk on the transition of the public utilities from small, independent and locally controlled enterprises to large interconnected systems financed and controlled by large centralized bodies of capital. Mr. Willcox thought this growth a natural outcome of the fact that the utility generally grows at a rate much in excess of the growth of the community and of its capacity to care for the necessary financing.

The definition of public utilities given by Mr. McCarter for the purposes of his lecture was "all street-using corporations operating under state or municipal grants, such as gas and electric supply, street-railway, telephone and telegraph companies." Before taking up the subject proper the speaker outlined the political situation in this country as he understands it. This has much to do with the public utility situation and with the present temper of the people with relation thereto.

In the first place the people distrust the public utility official. Mr. McCarter said that at one time he had occupied political positions of importance, but he realized that he has now and forever barred himself from political preference by occupying his present position. Two years ago, when president of the American Electric Railway Association, he, in company with other railway men, visited many of the important electric railway centers throughout the country, explaining the situation that confronted the companies. While he felt that the trip was well worth while, he humorously referred to the fact that the present disposition of the people toward electric railways showed no evidence of conviction produced as a result of his labors.

Mr. McCarter took occasion to register a vigorous protest against the seemingly prevalent opinion that a public-utility official cannot be as honest and as patriotic as other citizens.

Continuing, Mr. McCarter said that the political parties of the country have largely outlived their fundamental principles. While he personally is by tradition and choice a Republican, he really would have trouble in defending his position, so uncertain are the present tenets of that as well as of the other parties. It appears that what has occurred politically in England and Germany must eventually come about in this country, namely, a reclassification of the population politically into radicals and conservatives, old party demarcations being eliminated. The fate of public utilities is involved in this political situation because the new parties will disagree radically as to the management of these properties.

The principle of regulation is now accepted generally as desirable but the practical application of the principle involves many problems. Regulation as practised is expensive. It may also have a depressing effect on the value of securities. Since the provisions of the Hepburn bill went into effect railroad securities have depreciated in value by $3,000,000,000, and this is partly, at least, due to government regulation. To be successful commissions must be composed of men of the highest character and best experience. Moreover, they must be restricted to their real functions. The exercise of plenary powers is municipal ownership without responsibility.

The allowable rate of return, said Mr. McCarter, is a vital element of successful regulation. The conservative view is that a fair rate of return on a reasonable valuation should be provided for. There will obviously be no incentive to capitalists to put their money into such hazardous undertakings if rates are kept down without due regard to all factors involved. Just what is an average fair return the speaker was not prepared to state, but it should certainly not be less than 8 per cent.

In valuing property for the purpose of determining rates of fare due allowance must be made for franchises, depreciation, etc., but the tendency is against this. Commissioner Daniels, formerly of the New Jersey Board of Public Utility Commissioners and now of the Interstate Commerce Commission, was publicly criticised and the ratification of his appointment to the latter position was jeopardized because he was willing to make allowance for intangible values in rate-making.

In discussing franchises, Mr. McCarter said that there are many wrong impressions in the public mind. Existing franchises were in most cases granted to induce capital to build railways on the same principle as the federal government gave a vast acreage of public land to the Union Pacific Railroad to induce it to extend its lines. Franchises should not be limited in term. A limited-term franchise is like a limited-term lease of a lot upon which a valuable house is built. The only way in which such an investment is made feasible is by the creation of a sinking fund which will retire the value of the house during the period of the lease. An expiring franchise is a distressing spectacle, as has been seen in a few recent examples. During the last five years the property is allowed to run down and service is poor. There is now no valid objection to a perpetual franchise in view of the regulating tendency of the times. Such franchises should contain provision for periodical review to insure compliance with their provisions.

The chief objection to municipal ownership is furnished by the unsatisfactory results of municipal administration in this country. The theories of federal and state government have worked out well in the country, but this is not true of the city governments. Here graft, incompetent selection of officials and other evils have been conspicuous. When one considers the responsibilities already on the shoulders of municipal officials he concludes that they are enough.

Another serious item mentioned by Mr. McCarter is that of financing. Our cities now labor under serious financial burdens. If the electric railways of the country were purchased under a fair condemnation process, the burden would be enormously augmented. No one claims that cities could operate railways cheaper than individual companies, but it is supposed that they can borrow money cheaper. The fact is that if the cities were to go into public utility work on a large scale they could not get the money any cheaper than individuals, and even if they did, the losses due to less efficient operation would more than wipe out the difference. The only theoretical saving by municipal ownership is the difference between interest rate and the existing dividend rate, which would soon vanish in graft and mismanagement.

In conclusion, Mr. McCarter called attention to the efforts being made by public utilities for the welfare of employees. His own company has gone to the limit in this direction and a loyal spirit has been developed. Old-age pensions, sick and death benefits, participation in profits and other items of extra compensation are in effect. All of this is good, but after all real manhood is at the bottom of success and the future of the public utility depends on this.

Public Service Commission News

California Commission

The Railroad Commission of California has issued an order authorizing the Ocean Side Electric & Gas Company to renew $12,442 notes and issue $25,000 bonds. The company proposes to sell enough bonds to realize $14,100 and with the proceeds to pay the notes and reimburse the treasury for $1,656 expended on additions and betterments from income. Commissioner Loveland wrote the decision. He says that ordinarily when no depreciation account has been maintained the commission would demand that the treasury should be reimbursed for the $1,656 from income, but considering the uncontroverted testimony that the plant has been kept in excellent condition from income and that this amount has been expended for additions and betterments, he believes that the commission should approve the payment of this sum from the proceeds of the bonds.

Wisconsin Commission

The Wisconsin Railroad Commission has issued an order readjusting the rates of the Monroe Electric Company. An analysis of the investment and operating expenses showed that the revenues from commercial lighting were considerably in excess of the costs and that the cost of furnishing power exceeded the revenues derived therefrom. The present rates for commercial lighting, ranging from 15 cents to 10 cents per kw-hr., are to be abandoned and the following schedule substituted: Primary rate, 12 cents per kw-hr. for the first thirty hours' use per month of the active connected load; secondary rate, 9 cents net for the next sixty hours' use of the active connected load; excess rate, 4 cents net. The classification of consumers according to the percentage of their connected loads to be deemed active is the same as that used by the commission in the majority of its rate cases.

The rates for unlimited power service are to be as follows: Service charge, 80 cents net per month per active hp connected; energy charge, 3 cents per kw-hr. for the first 70 kw-hr. use per month of the active horse-power and excess rate of 2 cents per kw-hr. The active horsepower is to be graduated from 90 per cent of the first 10 hp connected to 50 per cent of all capacity over 60 hp. The order provides that where power consumers agree to use power during certain stipulated off-peak periods the service charge may be reduced 10 cents per hp.

The commission has authorized the Wisconsin Telephone Company and the Ashland Home Telephone Company, operating competing exchanges in the city of Ashland, to exchange property. According to the terms of the certificate, the Bell company will transfer to the Ashland Home Telephone Company its exchange and lines in the city of Ashland and will receive in exchange therefor the toll lines of the Ashland company with its exchange at Mellen and a valid title to the property now owned by the Northern Wisconsin Toll Line Company and the Bayfield County Telephone Company, which are to be acquired by the Ashland company. The latter company will also turn over to the Bell company $17,500 stock and a like amount of bonds, authority for the issue of which has just been granted.

In reversing the order of the lower court, the Supreme Court has sustained the contention of the Railroad Commission to the effect that the Chippewa County Telephone Company, although furnishing service to a few subscribers in the city of Eau Claire, was not doing a local exchange business and, therefore, its successor, the Citizens' Telephone Company, could not issue securities for the enlargement of the exchange and the extension of its service without first securing a certificate of convenience and necessity from the Railroad Commission.

Indiana Commission

In deciding the case arising from the issue of bonds proposed by the Indianapolis Water Company, the Public Service Commission of Indiana has made several interpretations of the law. The issue requested by the company was over $2,000,000, but only $476,000 was for other than refunding purposes. About $140,000 of the latter amount was intended to reimburse the treasury for sums expended out of earnings for new construction. To this the city authorities objected. They contended that the law did not intend that a utility should capitalize new-construction expenditures when it was possible to take the sums required from the earnings. The commission pointed out that the law provides that expenditures for new construction shall be capitalized. The bond issue was allowed, the commissioners asserting that the appraisal of the property, showed the values to be sufficient to sustain it.

Maryland Commission

Changes in the Maryland Public Service Commission law were made during the closing hours of the Legislature. One amendment gives the commission power to regulate the quality of gas. Another provides that when a franchise is once exercised by a public service corporation it cannot be abandoned. Still another amendment gives the commission jurisdiction over all municipal lighting and water companies which do a general business in competition with other corporations. The hours during which the office of the commission shall remain open were, by another amendment, fixed at from 8:30 a. m. to 5:30 p. m. instead of from 8 a. m. to 9:30 p. m., as formerly. The bill increasing salaries of the two associate commissioners from $5,000 a year to $6,000 a year was also passed.

The measure giving the commission authority over all public service utilities owned and operated by municipalities, counties, etc., except Baltimore city, arises from the fact that the commission has had much trouble with several municipally owned utilities in western Maryland and on the eastern shore, but has been powerless to control them.

Massachusetts Commission

The Haverhill Gas Light Company has withdrawn its appeal from the order of the Gas and Electric Light Commission for the establishment of an 80-cent rate and has abandoned the suit brought against the board by it in the United States Circuit Court. Litigation has extended over sixteen years, and the case is one of fundamental importance in relation to the rate-fixing powers of the commission. In 1898 the city government petitioned for a lower rate after the original company had sold out to the then Nevin interests. The board ordered an 80-cent rate and the new owners appealed to the courts. In 1909 the company was purchased by Stone & Webster, and in connection with a reorganization an effort was made to increase the capitalization. This led to a second petition for a lower rate, the original order for an 80-cent rate having been abandoned by mutual consent, and the commission issued a new order establishing an 80-cent rate dating from Feb. 1, 1913. Stone & Webster appealed from this ruling to the United States Circuit Court, and Mr. Robert M. Dodge, of Newburyport, Mass., was appointed master to hear the evidence. Many thousands of pages of evidence have been presented before the master, and the company enlisted the services of the ablest gas engineers in the country in the endeavor to show that it could not sell gas at 80 cents at a reasonable profit. In withdrawing the suit and establishing the 80-cent rate, the company will rebate the extra 5 cents per 1000 cu. ft. received from its customers since Feb. 1, 1913.

Current News Notes

Examination for Junior Railway Engineer.—The New York State Civil Service Commission, Albany, N. Y., has announced an examination on May 9 for the position of junior railway engineer, Public Service Commission, First District. The duties are to inspect the power houses and equipment of subway, elevated and street railways and of electric companies in New York City. Candidates must have had at least three years' training in a technical school of recognized standing and not less than one year's experience in electric railroad or electric lighting work or in the manufacturing or installation of electrical or mechanical apparatus. The salary is from $901 to $1,200 per annum. Applications should be in the hands of the commissioners before May 1.

* * *

Small Majority in Favor of "Home Rule" at Chicago Election.—A question of public policy presented to the voters of Chicago at the election of April 7 was the following: "Shall the State Legislature amend the act creating a state public utilities commission, approved June 30, 1913, so as to provide for home rule and control by the city of Chicago of public utilities within the city?" Much to the surprise of the politicians, the magic of the "home-rule" cry in public-utility regulation was not so effective as had been contended. The vote was in the affirmative, but the majority was so small that the effect on the Legislature will probably not be great. The figures were: Yes, 176,850; no, 168,682. Women voted as well as men, but their negative votes were almost in the same proportion as those of the men.

* * *

Souvenir Book for Baltimore Jovians.—An interesting feature of the joviation and rejuvenation of the Jovian Order held at the Emerson Hotel in Baltimore on March 31 was a souvenir booklet prepared and distributed by Mr. Melvin H. Jones, twelfth Triton. This booklet, which is possibly unique in the history of Jovianism, contains portraits of the Jovian officers in Baltimore, the names and members of the degree team and committees, the list of toasts, the menu and the songs for the dinner, the program of entertainment for the joviation, a brief outline of the objects of the Jovian Order and something about the Baltimore luncheon meeting, together with a list of Jovians in Baltimore and the names of the candidates. Advertisements of electrical concerns are included, and the whole forms a pamphlet of thirty-two pages bound in a striking cover.

* * *

Senior Engineers from Yale Visit Engineering Industries in East.—To round out their engineering education and obtain an idea of the practical methods of conducting large engineering industries, about 100 electrical and mechanical engineering students of the senior class of the Sheffield Scientific School, Yale University, spent the week April 1 to 8 inspecting some of the larger industries in the East. Among the places visited by the electrical students were the United Electric Light & Power Company's new station at New York, the Interborough Company's station in the same city, the General Electric Company's factory at Schenectady, the Niagara Falls Power Company, the International Paper Company, and the Ontario Power Company at Niagara Falls, the Union Switch & Signal Company, the Edgar Thompson Steel Works, the American Steel & Wire Company, the Westinghouse Electric & Manufacturing and also the Machine Company, the Macbeth-Evans Glass Company and the National Tube Company in the vicinity of Pittsburgh. Entertainments of various sorts were tendered the visiting students in the several cities by local alumni and the industrial firms.

* * *

SOCIETY MEETINGS

Forthcoming Meetings of the Philadelphia Jovians.—On April 23 the Jovian Electrical League of Philadelphia will hold a meeting at which Mr. Gifford Pinchot will deliver an address on "Conservation of Natural Resources." On April 30 Dr. William Draper Lewis, dean of the law school, University of Pennsylvania, will speak on "The Three Kinds of Monopolies, Their Effects and Remedies."

* * *

New York Electrical Society Visiting Meeting.—On Wednesday, April 22, at 3.30 p. m., the New York Electrical Society will hold a visiting meeting, the objective point being the Bush Terminal, Brooklyn. In Building No. 20 Mr. R. E. Ireton will give an illustrated talk on the electrical and other features of the Bush Terminal. Following Mr. Ireton's talk a tour of inspection will be made of this unique plant.

* * *

Jovian Electrical League of Southern California.—At a meeting of the Jovian League of Southern California held in Los Angeles, April 8, Mr. Frederick H. Vose, secretary of the National Credit Men's Association of Chicago, delivered an address on electrical credits. He deplored the lack of harmony and co-operation between the credit and sales departments of the average business house, and classed capital, capacity and character as the three most important factors to be considered in extending credit.

* * *

Brooklyn Edison to Send 100 Men to National Electric Light Association Convention.—At the meeting of the Brooklyn Edison Company Section of the National Electric Light Association held on April 14, the vice-president and general manager, Mr. W. F. Wells, announced that the Brooklyn Edison company had decided to send 100 men to the convention of the National Electric Light Association to be held in Philadelphia during the first week in June. The Brooklyn men will leave early on the morning of June 3 on a special train, arriving in Philadelphia in time for the opening session and remaining over for the public policy meeting on that night.

* * *

Delegates from Commonwealth Edison Section to Philadelphia Convention.—At the meeting of the Commonwealth Edison Company Section (Chicago) of the National Electric Light Association held at the Hotel Sherman on April 7 the result of the election of delegates from the section to the N. E. L. A. convention to be held in Philadelphia during the first week in June was announced. Ten delegates were elected as the result of a keenly contested election, at which all "Class B" members of the section in good standing had an opportunity to vote. The successful candidates were Messrs. Joseph Haas, A. H. Donahoe, W. J. Weyker, E. B. Conklin, James Dawson, E. R. Hansen, John J. Kelly, George Nelson, R. H. Williams and Albert Legge. At the meeting Mr. J. T. Mountain, assistant to the chief operating engineer of the company, gave an interesting lecture on "Egypt," illustrated by 100 colored lantern-slide pictures. Mr. L. H. Rose also gave an illustrated talk on "Over the Matterhorn." The meeting was also the occasion of the first appearance of the Commonwealth Edison Band, which is distinct from the Commonwealth Edison Orchestra.

Richmond's Development of a Historic Water-Power

The falls of the James River, one of the earliest hydraulic sites in America, now used, with steam auxiliaries, to pump water for and to light the city of Richmond, Va. By James M. Purcell

HISTORICALLY the development of water-power on the James River at the present site of Richmond, Va., was one of the earliest in the history of the American colonies of Great Britain. Later on, the city of Richmond became an important flour-mill center, shipping its products to all parts of the world, and these large flour mills were then operated by the water-power of the river.

At present there are thirteen developments at Richmond within the short distance of 2 miles. Two are hydroelectric plants, four supply energy to large paper mills, three others are in flour mills, and the remainder consist of a water-pumping station, two rolling mills and a woodworking plant.

The Early Water-Power Water-Works Plant

Richmond, with a population of 150,000, is situated on the James River at the head of tidewater and at the foot of an extensive series of natural falls. These falls within a distance of 9 miles have a drop of 112 ft. The James River is 450 miles long and drains a watershed of 6900 sq. miles, which receives an average rainfall of 42 in. per annum. There is a wide divergence between the maximum and minimum flow, the minimum running as low as 700 second-ft. at times.

The present article relates to only one of these developments, the Richmond municipal electric station. This plant is interesting in the fact that it is a reconstruction of an old pumping station and affords a good example of the high efficiency which can often be obtained by the redevelopment of a former water-power site. The location of the municipal plant was formerly occupied by an old pumping station of the city water-works. Water was taken from the river and pumped to a reservoir situated on a high bluff at an elevation of 150 ft. This plant has been in operation since 1840 and was equipped with overshot wheels and plunger pumps. The capacity was limited to about 5,000,000 gal. per twenty-four hours, and it was decided to abandon the old equipment in favor of a modern one. With the completion of modern sedimentation basins 4 miles above the plant, the impracticability and cost of running a pipe line from the basins to the plant made it inadvisable to attempt to continue operating the old plant.

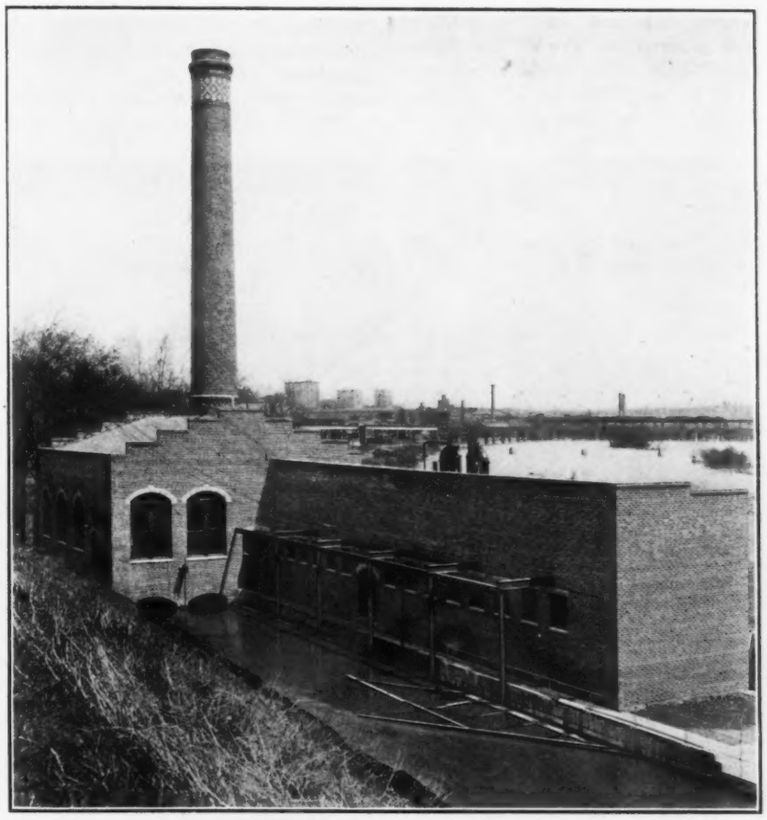


FIG. 1—STEAM-HYDROELECTRIC STATION ON THE JAMES RIVER AT RICHMOND, VA.

After much opposition the plan of constructing a hydroelectric plant on the site was adopted. This permitted the operation of electric pumps in the new pump house, situated 1½ miles above the old station, using energy generated at the electric plant. In addition, it was also possible to furnish street lighting and electric service to the municipal buildings, as the pumping service was mostly a day load. The completion and operation of the plant have amply justified its construction. The average demand for pumping has been about 6,000,000 gal. per day, with a maximum demand at times of 16,000,000 gal. The connected load at the pump house consists of six 200-hp Westinghouse motors, connected to two-stage centrifugal pumps working against a head of 165 ft.

The dam is a monolithic concrete structure, its average height being 15 ft. The total length of the dam is 2200 ft., extending into the stream, however, only about 400 ft. and taking an almost parallel course with the shore line. The dam does not reach across the river, as the riparian rights extend only to the center line of the river. At the center it touches the Belle Isle dam, which takes the other half of the river.

The pondage is very small, being only about 13 acres, and the plant depends almost wholly upon the flow of the river, which averages about 2500 second-ft. At the intake to the headrace eight gates are provided completely to shut off and to regulate the water in the race. The length of the

race from the plant to the headgates is about 500 ft. The race level is the same as that of the openings, and the overflow goes over the dam crest. Trash racks are provided at the wheel-pit openings. There is also a drop-gate arrangement, consisting of heavy plates, for completely blocking individual pits in case repairs are to be made to the wheels.

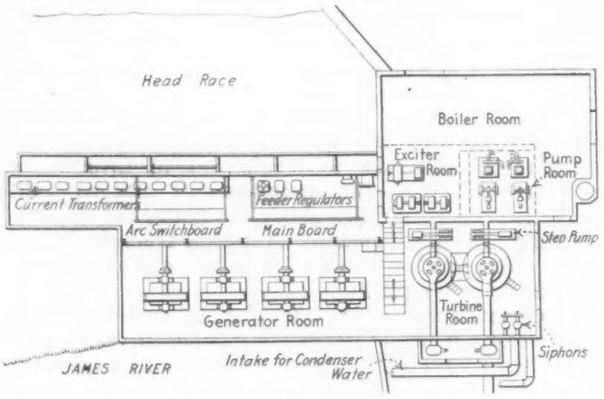


FIG. 2—PLAN RICHMOND MUNICIPAL LIGHTING PLANT

The design of the power house was fixed to a certain extent by the foundations of the old plant. Wherever possible the walls of the old building, which were of dressed granite and in excellent condition, were used. The building is constructed in the shape of an "L" with a length of 168 ft. and a width of 75 ft. The old wheel races were reinforced with steel and concrete and served as chambers for the waterwheels. Some excavating had to be done for the 6-ft. draft tubes, which extended from the wheels under the building and at right angles into the river.

At present there are four Morgan Smith 42-in. wheels directly coupled to General Electric waterwheel-type alternators. The 425-kva alternators are of the three-phase, four-wire, 4000/2300-volt, sixty-cycle, revolving-field type and run at 150 r.p.m. The wheels operate under a normal head of 18 ft. Lombard governors are

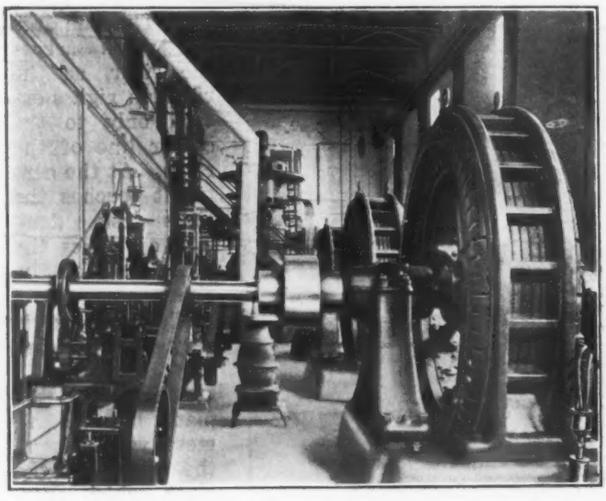


FIG. 3—GENERATOR ROOM, RICHMOND MUNICIPAL STATION

connected to each machine and are arranged for control from the switchboard.

As there are short periods of low water when the wheels cannot be run at full capacity an auxiliary steam equipment, consisting of two turbines, is provided. These turbines are of the General Electric Curtis vertical type and are coupled to revolving-field generators. The turbines operate at 150 lb. steam pressure and exhaust into a 27-in. vacuum. The generators are rated at 1000 kva at 75 per cent power-factor and produce sixty-cycle, 4000/2300-volt alternating current at 1800 r.p.m. The turbines exhaust into Alberger barometric condensers. Two vacuum and circulating-water pumps are also provided. The circulating pumps are piped so as to be interchangeable on either condenser and have connections, also, for drawing water either from the headrace or the river.

The boiler room is practically the only part of the building in which new walls had to be erected. It is built over two of the old wheel-races, which were reinforced with steel and concrete and now serve admirably for the pump and exciter rooms. The boiler room is about 46 ft. by 62 ft. and has a storage space in front for 150 tons of coal. Two Babcock & Wilcox 400-hp boilers are set up in the boiler room. The stack is built of radial brick and is 120 ft. high, with a diameter of 8 ft. A Locke damper regulator is connected in the flue leading to the stack. Two feed-water pumps are located in the boiler room and arranged either to draw water from the race or from the city mains in case of necessity. The exhaust from the step-bearing pumps, condenser pumps and feed-water pumps passes through a National feed-water heater. All firing is done by hand. Running condensing, with 28-in. vacuum, one boiler has been able to carry full load on the turbine.

All steam and exhaust mains have been lagged with pipe covering. These mains are also painted distinguishing colors. The main steam lines are a buff color, the exhaust pipes are red, the low-pressure lines to the siphons are yellow, and the boiler feed-water lines are white.

As the engine-room floor is at times below the river level, the drainage of the building does not empty into the river but into a tank. In case of high water this tank is drained by means of two siphon pumps. The building is well lighted both naturally and artificially. Altogether there are about 160 16-cp lamps mounted in five-lamp and six-lamp clusters on side-wall brackets and suspended from roof beams.

The exciter equipment consists of two units, which

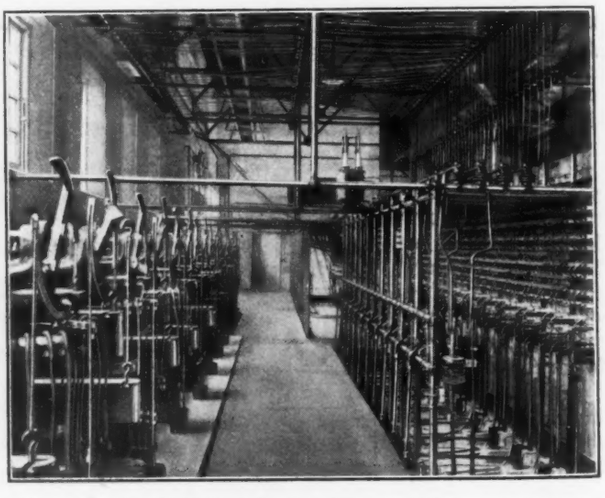


FIG. 4—TRANSFORMERS FOR ARC CIRCUITS, RICHMOND

are situated in a room directly under the boiler room and slightly above the level of the engine floor. These exciter sets comprise two 50-kw compound interpole generators directly connected to 4000-volt induction motors. A Pelton waterwheel is set up in the exciter room and belt-connected to the exciters. This wheel is connected to the city water mains, at a pressure of

about 80 lb., and is used to start the exciters. The exciter voltage is built up sufficiently to raise the alternating-current voltage so as to have the induction motor, which is connected to the exciters, reach its normal speed. The Pelton wheel is then cut out and the belts shifted to the idle machine. The Pelton wheel is controlled by the operator by a valve from the switchboard gallery.

The switchboard gallery is directly over the wheel and about 15 ft. above the engine room. It contains two switchboards, the main or generating panel and the arc board. The plant is operated on the three-phase, four-wire system at 4000/2300 volts—that is, 4000 volts between phases and 2300 volts between phase and neutral.

The main board at present consists of nineteen panels of blue Vermont marble mounted on pipe and with oil switches mounted directly on back of board. Two induction-motor starting panels are equipped with oil switches and starting compensators. Two Tirrill voltage regulators are also mounted on these panels. The five generator panels are provided with oil switches, field switches, governor control switch, three ammeters, a wattmeter, a voltmeter and a field ammeter.

There are two three-phase and three single-phase feeder panels, each equipped with ammeters, relays and watt-hour meters. In addition to these, the single-phase panels have compensating voltmeters and are arranged to feed through motor-operated automatic feeder regulators. These single-phase lines are connected together through the regulators and distributed as a three-phase, four-wire circuit.

Richmond City Street Lighting

The arc-circuit switchboard consists of eleven blue Vermont panels and has transfer buses and plug switches arranged so as to allow the interchange of any circuit from a damaged transformer to a spare unit. Four buses are arranged back of this board and taps are taken off between one phase and the neutral for 2300 volts, the load being equally divided among the phases. The arc lines are protected by horn-gap arresters and the power lines by multi-gap arresters. A

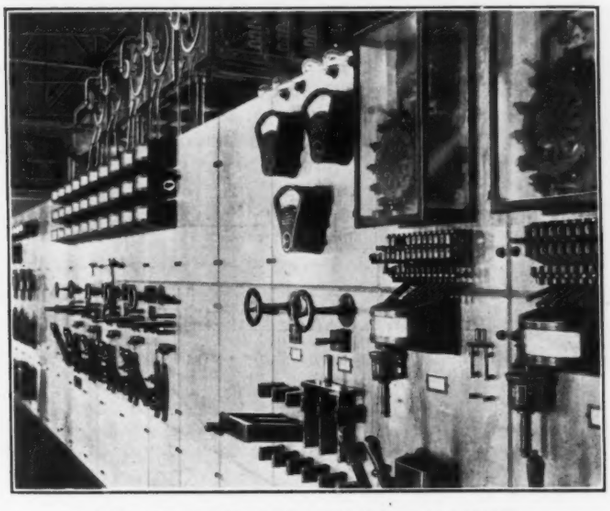


FIG. 5—MAIN SWITCHBOARD, RICHMOND

General Electric aluminum arrester is connected to the multiple lines.

The present outside street-lighting equipment is as follows: 1189 500-watt inclosed carbon-arc lamps, 137 alternating-current flame-arc lamps, 273 80-cp series incandescent lamps, 145 500-watt tungsten cluster, multiple series (operated until 1 a. m.), and 13 500-watt tungsten cluster, multiple series (operated all night).

Broad Street, the principal retail business street of Richmond, is one of the best-lighted thoroughfares in the country. Ornamental posts with five 100-watt tungsten units mounted on each standard are set up on both sides of the street. In addition to this, pairs of flaming-arc lamps are suspended from 30-ft. poles set

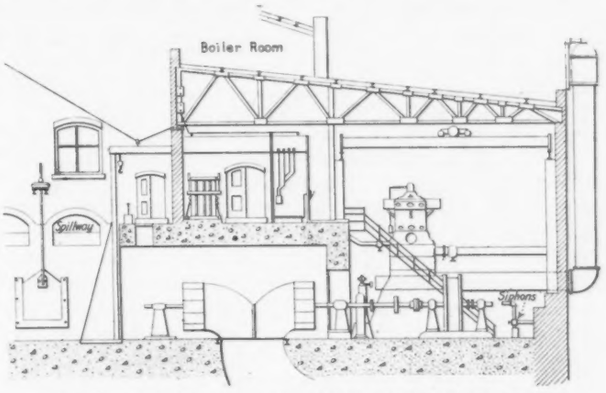


FIG. 6—SECTION OF RICHMOND MUNICIPAL PLANT

up in the center of the streets at each street intersection.

At present there are twenty-two arc circuits in operation. These circuits are carried on a trunk line for about one-half mile and are then distributed on 35-ft. poles throughout the city. No. 6 rubber-covered wire is used. In the business part of the town and in the underground districts the lamps are fed through lead-covered cable laid in fiber ducts. The overhead line is connected to the underground circuit through series transformers, thus lessening the insulation strain should the overhead lines be struck by lightning. These series transformers are wound for a current ratio of 7.5 amp to 10 amp. All the lamps in the underground district are of the flame type and take 10 amp each.

Two three-phase 4000-volt transmission lines are run to the new pump house about 2.5 miles distant. These lines supply energy to six 200-hp induction-motor-driven centrifugal pumps. A three-phase, four-wire,

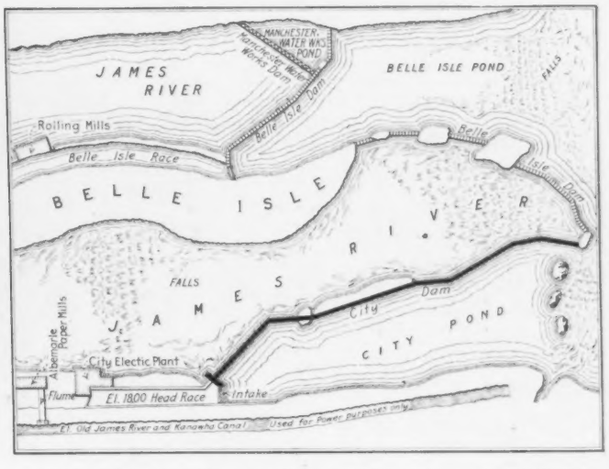


FIG. 7—DAMS AND PONDS, BELLE ISLE, RICHMOND

2300-volt line is run to the retail business district, where it is fed through transformers to 145 ornamental poles and to municipal buildings. These poles carry five lamps each of 100 watts rating.

Mr. E. W. Trafford, who designed the plant, is now in charge of its operation as superintendent and city electrician.

Service Continuity in Grounded Transmission Systems

Notes on new methods that have been tried in actual practice by the Peninsular Power Company, of Iron Mountain, Mich. By Max H. Collbohm

THE question of preference between a grounded and an ungrounded system for high-voltage transmission has come into prominence recently, and a few notes descriptive of some new methods tried in actual practice may be of interest. Dr. C. P. Steinmetz[1] has cautioned against grounding a transformer neutral in systems operating a few feeders only, such as obtain in long-distance transmission, and has advocated that such systems be insulated. In the spring of 1911 the writer designed a transmission plant for operation with a grounded neutral wherein the disadvantages inherent in an ordinary grounded system, as mentioned by Dr. Steinmetz, have been anticipated and means devised to overcome them, thus obtaining all the good features of the grounded system and none of the bad ones.

The disadvantages of a grounded system, the methods worked out to overcome them, and the results obtained in actual operation will be discussed in the following paragraphs.

Service Interruption by Ground on Line

Dead-grounding of the neutral will automatically open a line switch in case of a ground on the line.

Grounding through a resistor will also open the line switch under such conditions either automatically by the combination of load current and ground current actuating the relays, or by the operator after the limit of the heat capacity of the ground rheostat has been reached.

To prevent the line switch from opening automatically the scheme shown in Fig. 1 was developed. It consists of a series transformer in the ground connection of the grounding rheostat the secondary of which is connected to an instantaneous overload circuit-opening type relay, having its contacts inserted in the tripping circuit between the main relays of the line switch and the tripping coil of this line switch. The idea of this scheme is to open the tripping circuit by the instantaneous relays first before the inverse-time-limit relays have closed their contacts. The existence and severity of the ground are indicated by an alarm bell, a signal lamp and an ammeter.

DATA ON LIGHTNING DISTURBANCES IN 1913

Date	Duration, Hours	Number of Interruptions	Total Duration, Seconds	Insulators Damaged
April 2	4.5	0	0	0
May 3	2.0	0	0	0
June 5	6.0	0	0	0
June 18	6.0	1	1	0
July 1	2.0	0	0	0
July 3	3.0	0	0	0
July 4	2.5	0	0	0
July 5	2.5	0	0	0
July 26	6.5	0	0	0
July 31	1.5	2	2	0
August 3	4.0	0	0	0
August 7	3.0	0	0	0
August 8	3.0	1	1	0
August 14	1.5	0	0	0
August 16	2.0	0	0	0
August 28	1.5	0	0	0
September 2	5.0	0	0	0
September 6	1.0	0	0	0
October 10	2.0	0	0	0

This arrangement permits the operator to cut out the line in trouble without service interruption in the following way: If a ground occurs, the operator will trip

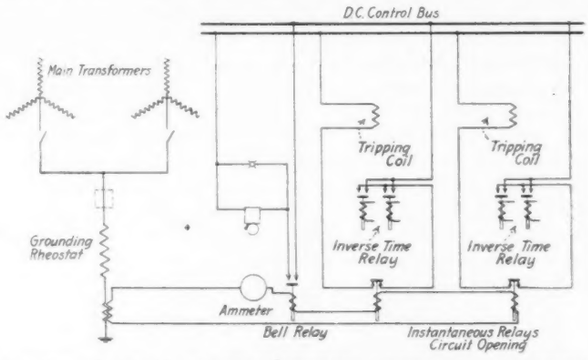


FIG. 1—DIAGRAM OF CONNECTIONS BETWEEN GROUNDING RHEOSTAT AND LINE SWITCHES

one of the line switches (of a duplicate line), and if the trouble should be on the line controlled by that switch the reverse-power relays at the substations will open the line from the other end. If, however, the ground is on the other line (the bell continuing to ring), the operator will then again close the first switch and trip the other, which will clear the line in the manner just mentioned without service interruption. For greater reliability the reverse-power relays at the substations may be installed in duplicate.

If a ground occurs on a single line and does not burn itself free within the allowable heating period of the rheostat, the line conductor in trouble should be grounded over an oil switch and the transformer neutral opened. Repairs could then be made on this grounded conductor and the same placed in normal operation again without service interruption.

Unreliability of Grounding Rheostat

It is extremely difficult to design a self-contained rheostat that will withstand the high voltage of a high-tension transmission system and offer at the same time more than a low factor of safety against flash-over. This difficulty has been overcome by building the rheostat in five separate sections connected in series, each section being placed on high-voltage insulators in a separate brick compartment. This arrangement permits of building each rheostat section for only one-fifth of the voltage in question, and the factor of safety against flash-over and the consequent reliability of the apparatus itself are by the use of this method materially increased.

There is little probability of such a rheostat becoming a source of oscillatory arcing on account of the grounded nature of the system. If any doubt should

[1] *General Electric Review*, June, 1913.

exist as to the permanency of its reliability, the system could momentarily be changed into an insulated one by opening the transformer neutral with the aid of an oil switch.

Damage to Insulators by Arcing

The probability of damage to insulators from an arc in a grounded system is usually greater than in an

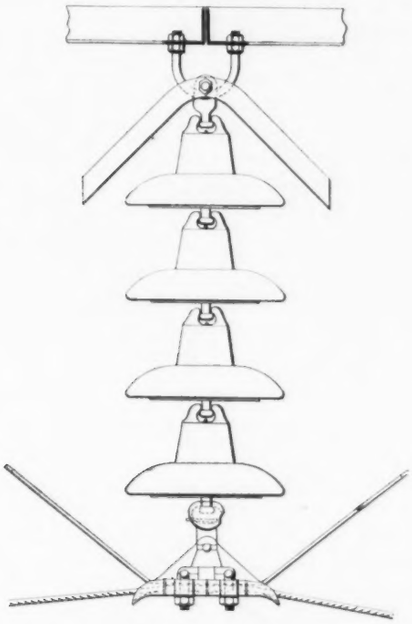


FIG. 2—ARRANGEMENT OF ARCING RODS ABOVE AND BELOW INSULATORS

ungrounded system if the arc is maintained. This feature has been eliminated by the installation of arcing rods (see Fig. 2) above and below the insulators which lead the arc away from the insulators as soon as it is formed. They act further as a relief gap owing to the concentrated electrostatic field at their sharp ends and may therefore be considered individual lightning arresters for each set of insulators where they are installed.

The various schemes outlined have been put into actual operation in the system of the Peninsular Power Company, of Iron Mountain, Mich., the station wiring of which is shown in Fig. 3. As will be noted, there has been provided beside the equipment above discussed additional protection in the form of choke coils in each circuit connecting to the generator busbars. The choke coils are wound with Swedish iron so as to obtain high ohmic resistance under high-frequency surges entering over the low-tension local feeders. For the same reason each series transformer on the outgoing lines is shunted by a small electrolytic cell and a high-frequency condenser arrester placed on the low-tension busbars in addition to the usual electrolytic arresters and choke coils on the outgoing lines.

The transmission line, which is in duplicate (40 miles, 66,000 volts), is equipped over the entire distance with two copper-clad ground wires of No. 2 B. & S. gage arranged 10 ft. above the main circuit wires and grounded at every tower by special ground plates attached to the tower legs and extending below the concrete foundations.

With the above-mentioned equipment high-tension service was maintained during the lightning season of 1913 with a record of disturbances from lightning as given in the accompanying table, which has been compiled from the station log sheets.

On an examination of the tabulated figures it will be seen to be evident that during nineteen lightning storms, each lasting over three hours on the average, there were only four service interruptions, each of one second duration only, which means practically no interruption at all. A most significant fact is the complete absence of insulator failures, especially in a territory which has become notorious for the severity of its lightning storms.

It may be of interest to note that the grounding rheostat with the above-described interconnection between it and the line switches has also given important service during the construction of the transmission line. This line was originally built with a single three-phase circuit in order to allow of discontinuing steam operation at the substation at the earliest possible moment. Immediately after this first circuit was placed in operation a second circuit was strung on the same towers. By keeping the conductors of the second circuit well grounded no harm befell the linemen and practically uninterrupted service was maintained throughout despite fifty or more accidental grounds caused by the

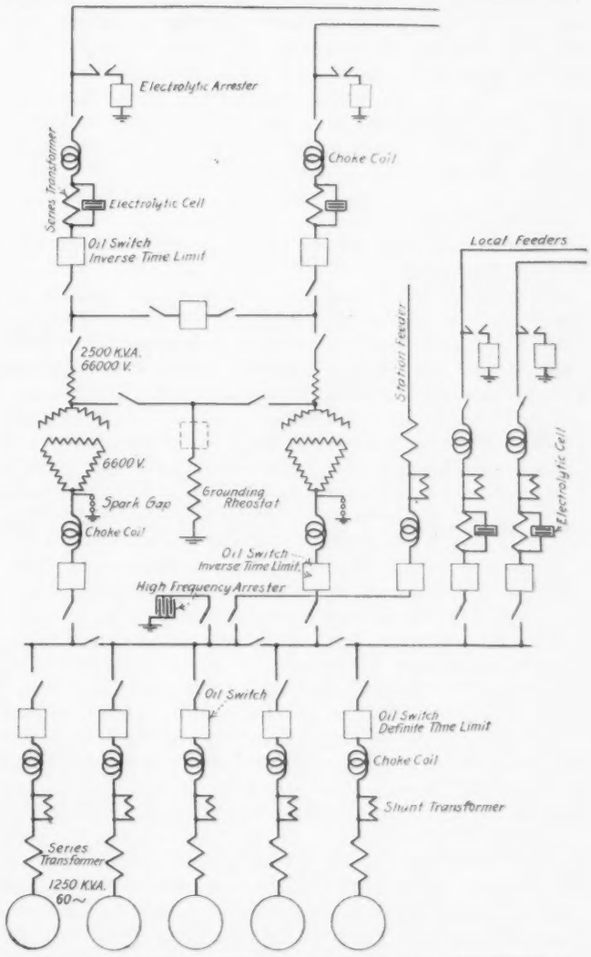


FIG. 3—STATION WIRING DIAGRAM OF PENINSULAR POWER COMPANY

second line coming in contact with the live line due to strong winds.

From the above it appears that with an equipment as described practically absolute continuity of service can be maintained in a grounded system without interfering with the convenience of operation or endangering the equipment.

Design of High-Tension Porcelain Insulators

Mechanical, electrical and commercial considerations which must be taken into account in the design of pin-type and suspension-type insulators—Characteristics of various types. By Walter Claypoole

THE modern high-tension insulator, though far from perfect, is still a very fine product of skilful design, excellent material and careful manufacture. In fact, it may be said that the upper limits of pressure on transmission lines will not be fixed by the limitations of the insulator itself but more probably by prohibitive coronal losses. The design of a high-tension insulator presents peculiar problems which are not rendered any simpler by the fact that the voltage is alternating.

The designer must take account of the following considerations: Dielectric strength of air; dielectric strength of porcelain; surface resistance of porcelain—wet, moist, dirty, etc.; capacity effects within the insulator itself; capacity effects as between the insulator, line and earth; ionization of air in contact with highly charged surfaces. Moreover, the designer should not lose sight of the fact that the insulator must be sound mechanically and capable of production at a reasonable price. However, the question of cost, though of great interest to the financial backers of the line, should not be allowed first place.

The most suitable material from every point of view for the construction of a high-tension insulator is porcelain. It has a high dielectric strength and can be produced in an absolutely non-porous form. Compared with glass its surface is very much less hygroscopic, and it has considerably more mechanical strength. When made of carefully selected materials and under suitable conditions its good qualities are permanent and do not appear to change in the least under continued electric stress.

As is well known, two principal patterns of insulator are used for high-tension work, namely, the pin type, which is useful up to about 60,000 volts, and the suspension type, used for higher pressures. The necessity for the latter type arises from the fact that high pressures call for excessive size and therefore weight, when single units are employed, and it is easier to take care of a high tension, such as 100,000 volts, when it is divided among several insulators in series.

In designing an insulator the point of view should always be the break-down pressure and not the line pressure—what the insulator will withstand, not what it should withstand. The break-down of the line at an insulator may be temporary or complete. When the porcelain suffers puncture the air-flash path of perhaps a foot is reduced to only an inch, so that an insulator which would withstand 100,000 volts becomes a species of arc lamp operating somewhere in the neighborhood of 10,000 volts. Such complete break-down can be remedied only by the replacement of the piece which is defective.

In some cases a "flash-over" followed by a "dynamic arc" may cause interruption and it is often an even chance whether or not the porcelain shells survive the heat of the arc. However, such an accident need not necessarily mean complete disablement. Very often the insulator is adequate for the normal voltage and breaks down again only on the occasion of a surge or other abnormal condition.

Design Tests

The following values arranged in order of increasing magnitude are those usually specified: Wet flash-over pressure; dry flash-over pressure; puncture pressure. Of these the first and third, which are of prime importance, are defined thus: "Wet flash-over" pressure, or "rain test," is the applied pressure at which a spark

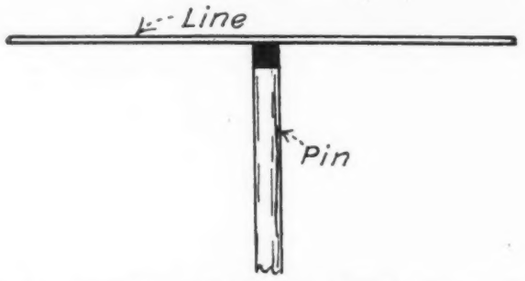


FIG. 1—PORCELAIN BLOCK BETWEEN LINE AND PIN

passes from the line to the pin over the surfaces and edges of the insulator when it is subjected to a fine rain driving at an angle of 45 deg. from the vertical and in quantity equivalent to a precipitation of 1 in. in five minutes. "Puncture pressure" is the voltage at which an actual rupture of the porcelain dielectric occurs. On making a puncture test on a properly designed insulator it must be immersed in transformer oil so that a flash-over cannot take place, the puncture pressure being much higher than the flash-over pressure.

Opinions as to suitable factors of safety differ. At the higher pressures, especially, a compromise is reached between what is commercially possible and what is demanded by the particular exigencies of the case.

Generally accepted ideals, with the line pressure as unity, are: Wet-test flash-over, 2; dry-test flash-over, 3; puncture pressure, 4.

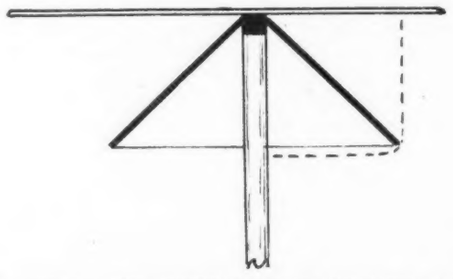


FIG. 2—DEVICE FOR INCREASING FLASH-OVER VOLTAGE

Quality of Porcelain and Its Effect on Design

The design of an insulator involves questions of weight, wall thickness and extent and arrangement of leakage surfaces, the object in view being the attainment of maximum resistance to flash-over and puncture, combined with high mechanical strength and minimum weight. The weight, of course, cannot be unduly dimin-

ished, as this would involve mechanical weakness as well as liability to puncture, but, speaking generally, it should be as low as is compatible with safety in these two directions. The weight of an insulator for a specified voltage depends primarily on the resistance to puncture possessed by the porcelain. This figure differs for materials of different origin and manufacture and appears to depend very largely on the quality of the china-clay, one of the three ingredients. Silica and felspar as found in various parts of the world are very much more uniform than is china-clay. The last-mentioned, being a disintegration product, possesses qualities analogous to those brought about by "aging," and the date of the deposits undoubtedly largely affects the character of the manufactured porcelain. The kaolins of Ohio, Germany, France and China are all different and valuable in their several ways. German porcelains possess qualities particularly suiting them for electrical use.

The china-clay that is found in certain deposits in the neighborhood of Carlsbad is remarkably free from metallic deposits and is of a very homogeneous char-

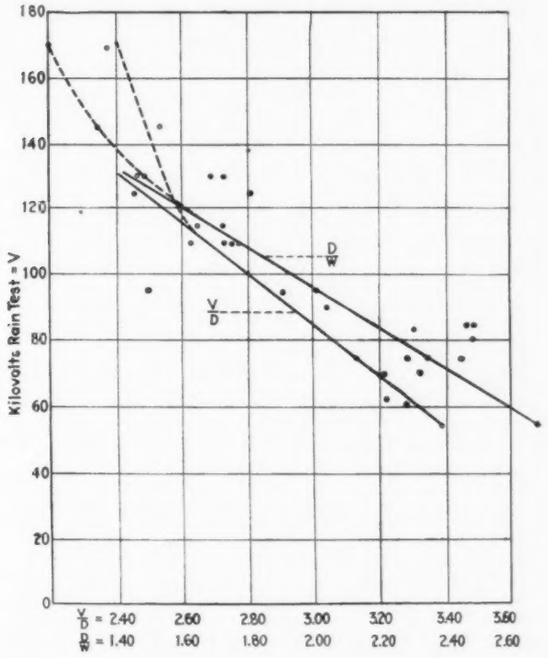


FIG. 3—FLASH AND DESIGN FACTORS OF TWENTY-FIVE PIN-TYPE INSULATORS

acter. These natural attributes are enhanced by special manufacturing methods whereby a still further degree of purity and density of body is arrived at. German porcelain generally has the reputation of possessing extremely high dielectric strength. Certain Bavarian porcelains in plates 1 mm thick will not puncture below 10,000 volts and in 10-mm plates will withstand 80,000 volts. These figures are not possible with porcelains of American manufacture, among which it is rare to find a sample of higher dielectric strength than 55,000 volts for a 10-mm plate.

Elements of Design

In designing an insulator for a specified voltage the first dimension to be settled is the shell thickness between the live line and the earthed pin. The thickness will depend on the known value of the dielectric strength of the porcelain and should be sufficient to withstand from four to five times the line voltage. Liability to puncture, however, is not confined to the head. The petticoats are also vulnerable, and insufficient thickness here will involve the risk of fracture on the occurrence of a heavy surge.

When material of high specific dielectric strength is available, a lighter construction is possible, and experience has shown that in such cases if the piece be designed with petticoat walls sufficiently thick to insure adequate mechanical strength, the electrical qualities will also be entirely satisfactory.

The next consideration of design is the extent and arrangement of the leakage surfaces.

The shells or petticoats perform two functions:

1. The surface resistance is increased by the increase in the leakage path.

2. The voltage required for flash-over is increased by extending the air-flash path.

Fig. 1 shows diagrammatically a line and a pin separated by a small porcelain block. Suppose this to be 0.5 in. thick and of the same diameter as the pin. The puncture distance, flash distance and leakage distance are in this case all equal, and while 0.5-in. porcelain would withstand a puncture pressure of 100,000 volts, it is evident that with this arrangement flash-over would occur much below 20,000 volts. In any case the small leakage path would soon acquire a film of dirt sufficiently conducting to allow the passage of a pilot current which would be immediately followed by a flash-over and an arc. The flash-over might occur at quite a low voltage if sufficient time were allowed for the growth of the surface film.

The obvious improvement, as shown in Fig. 2, is to extend the porcelain into the form of an umbrella so as to increase both the leakage distance and the air-flash path. The latter is shown dotted. It is obviously quite easy by this means to increase the air-path resistance to a value equivalent to the dielectric strength at the head, thus making it an open question whether break-down will take place through the porcelain or round the edges.

When the porcelain shell is perfectly clean and dry the flash will be entirely through the air, but in any other event it may strike on to the surface, preferring the easier path of the dirt film. When the insulator is exposed to rain, the outside surface of the petticoat becomes a partial conductor and the air-flash path is correspondingly reduced. In the limit, the flash may be considered as taking place between the edge of the shell and the pin, thus reducing the flash-over voltage practically by one-half.

Still further improvement is possible. It will be found that if the insulator in Fig. 2 be put into service its usefulness will decrease with time owing to the inadequate leakage path. Pilot sparks, taking advantage of the semi-conducting film, will enable flash-over to occur at lower and lower voltages. The addition of a second petticoat suitably arranged, while adding nothing to the dry flash-over voltage, will considerably improve the performance when wet and enable the insulator to withstand service conditions which would otherwise be too severe for it. Additional shells mean still greater leakage path, but the very considerable increase in weight is not usually justified.

Design Characteristics of Pin-Type Insulators

Three quantities of prime interest are:

Rain-test voltage $= V$
Leakage distance $= D$
Total weight $= W$

It is convenient to call $D \div W$ the design factor and $V \div D$ the flash factor.

The two elements entering into the production of a first-class insulator are high-grade porcelain and good electrical design. The better the material, the higher it is possible to make $D \div W$, and the better the design,

the higher will be the ratio $V \div D$. If for a completed range of insulators the above two ratios are plotted each with respect to V, it is possible to discover which units of the series are correctly and economically designed. It is evident that porcelain of constant electrical quality should permit the construction of a range of insulators the design characteristics of which follow some definite law.

Examine the group of points representing $D \div W$. Assuming perfection of design, it should be possible to draw a curve through all the points. Each insulator should have a mutual relationship with every other in the series. The more erratic the design the more difficult will it be to draw the representative curve.

In Fig. 3 the full points show the ratio $D \div W$ plotted against V for twenty-five different insulators of the same make, covering a range from about 50 kv rain test to 170 kv. The ratio $D \div W$ is expressed as the leakage distance in inches divided by the weight in pounds.

It will be seen at once that the designs are very erratic. There are, for instance, eleven insulators, covering a voltage range from 60 kv to 85 kv, which occupy a considerable area. The center of the group is somewhere in the neighborhood of 75 kv, and $D \div W = 2.34$. As there happens to be an insulator at this point, the curve has been drawn through it.

Further up the series there are two insulators for 130 kv and one for 125 kv, which obviously have little relation to the rest of the series. If a straight line be drawn from the insulator at 54 kv to the intersection of $V = 120$ and $D \div W = 1.60$, it will represent the grouping fairly well.

For those insulators lying near this curve the ratio $V \div D$ is marked by circles. The result shows that a straight line can be drawn to cover the insulators at 54 kv, 75 kv, one of the two at 110 kv, and that at 115 kv. There are thus four insulators out of twenty-five which are covered by both curves, and observation will show that no other regular curves can be drawn to cover any insulators other than these same four. A simple proof of this statement can be obtained by the aid of Fig 4. This gives the ratio of flash-factor to design-factor for each of the twenty-five insulators in the list, and a curve has been drawn through the points representing the above selected four insulators. These are shown in full black. Suppose now any other selection whatever be made of points on Fig. 4 through which a curve can be drawn and the same points located on Fig. 3; it will be found that they can be joined only by zigzag lines. In other words, their design follows no regular law. The author contends that the insulators found on *both* ratio curves are designed on economical and sound lines.

The ratio curves would furnish an equation illustrative of both the excellence of the material and the skill of the designer. Their slope and position would depend partly on the high dielectric strength of the porcelain and partly on the cleverness of the design. Consistency of design would be shown by the large proportion of insulators lying on both curves.

Reverting to Fig. 3, it is instructive to notice one of the three insulators listed at 95 kv. It lies on the $D \div W$ curve, but is very wide of the $V \div D$ curve; whereas the value of $V \div D$ at 95 kv should be 2.86, the flash-factor is only 2.50. This insulator would seem to be very badly designed. According to dimensions given in the manufacturer's catalog, it has a leakage distance of $95 \div 2.5 = 38$ in., a weight of 19 lb., and flashes wet at 95 kv, whereas a correctly designed unit should withstand the same test with a leakage distance of $95 \div 2.86 = 33.3$ in.

Suppose now an attempt be made to improve this unit and bring it into conformity with the rest of the series. The reduction of D will naturally reduce W if the thickness of the material remains the same. It is probable that the considerably reduced leakage distance, even with improved shape, will involve some reduction in the wet test voltage. Suppose this is now 94 kv. The curve shows that the value of $D \div W$ should be 2.03 and of $V \div D$ 2.88. To satisfy the latter value, D would have to be 32.7 in, and this being supplied in the other ratio $D \div W$ makes $W = 16$ lb.

The first and second designs therefore stand in the following manner:

1. Bad shape: $D = 38$ in. $W = 19$ lb. $V = 95$ kv.
2. Good shape: $D = 32.7$ in. $W = 16$ lb. $V = 94$ kv.

It is evident that the great increase of the flash-factor while keeping the design-factor nearly constant can only be brought about by careful re-design of the insulator. There is another unit in the series which could be greatly improved with a little alteration. One of the three at 130 kv has the following ratios: $V \div D = 2.46$; $D \div W = 1.47$. Its weight is 36 lb. and leakage distance 53 in.

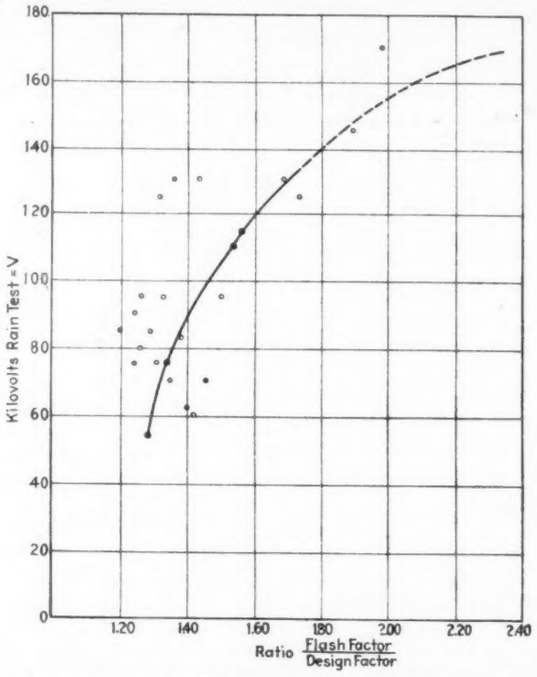


FIG. 4—METHOD OF SELECTING BEST DESIGNS IN A GIVEN SERIES

To put both points on the straight lines representing the respective ratios would mean that D must be 54 in. and W 37.5 lb. Putting about 0.5 in. on the edge of a shell, thus adding 1.5 lb. to the weight, would suffice to place this insulator in its proper location in the series.

Above 120 kv the straight-line ratio laws appear to break down. This result would lend force to the argument that the pin-type insulator is only suitable up to line emf of about 60,000 volts. The $D \div W$ ratio has been continued dotted through the insulators at 130 kv, 145 kv and 170 kv. There is a steady curvature away from the voltage ordinate; that is to say, the $D \div W$ ratio is greater than it should be for any particular voltage. At the same time the corresponding values of the ratio $V \div D$ are not only higher than they should be; they are also erratic.

From what has gone before the following conclusions can be drawn:

1. The leakage distance is much too small ($V \div D$ too high).
2. The weight has been unduly cut down ($D \div W$ too high).
3. The petticoats are unskilfully designed ($V \div D$ points badly placed).

The curve in Fig. 5 has been drawn to represent the relation of weight to rain-test voltage, the weight for each voltage being calculated by reference to the ratio curves in Fig. 3. For instance, at 100 kv Fig. 3 gives the value of $V \div D$ as 2.79, so that D should be 36 in. At the same voltage the value of $D \div W$ is 1.91, so that the weight should be 19 lb. In the same way values of W have been calculated for all other voltages. The actual catalog weights of the insulators were then plotted, the four selected units from Fig. 3 being shown by open circles.

The dotted continuation of the curve in Fig. 5 was

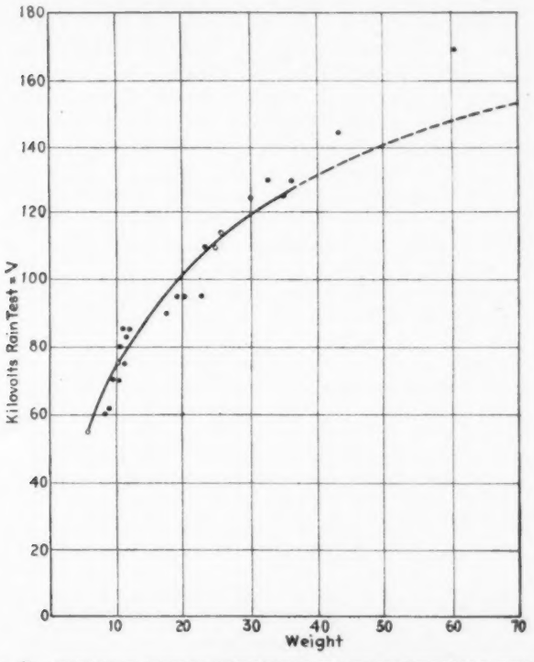


FIG. 5—WEIGHT CURVE APPLYING TO BEST DESIGNS SHOWN IN FIG. 3

laid down on the assumption of straight-line ratio laws carried beyond 130 kw.

Suspension Insulators

There are sufficient arguments in favor of suspension insulators for extra high-tension without dwelling on the ease with which a line can be fitted for higher voltage by adding units to the string. Notwithstanding belief to the contrary, this is not a favorite amusement of distributing engineers.

No line can be made immune from trouble. All that can be done is to adopt systems and designs which costly experience has shown tend in the general direction of that happy state. It is, above all, important to guard against the complete hold-up of the line which follows on the destruction of an insulator. The delays and expense consequent on this event are so serious as to lead to the adoption of heroic measures, such as the installation of arcing rings, the use of a ground wire above the line, and so on. The temporary break-down which accompanies flash-over is unimportant so long as the porcelain survives. Careful design of the units, individually and as a string, will enable heavy arcs to be withstood practically without damage.

Suspension insulators follow three main types—plain disk, corrugated disk, and two-piece cemented. For a given wet "flash-over" test the plain disk has the least weight and the corrugated disk has the least diameter. The cemented two-piece is a heavy pattern, but for extra high voltages fewer units in series are required than if either of the other types is used. The plain disk pattern is simple and appears to hold the arc less than does the corrugated style, but it is hardly suited for use on extra-high-tension lines.

The insulator of the future will have to be capable of doing good service on lines operating at line pressures of at least 150,000 volts. What the upper limit will be for commercial transmission does not appear at the moment to be agreed on, but may possibly be as high as 175,000 volts.

An insulator string suitable for such a line pressure would have to withstand a wet test of 350,000 volts.

It is practically certain that there does not exist at present a suspension-type insulator of sufficient stamina to qualify for use on a tension as high as this. It is not merely a question of adding units on a string. That seven times 50,000 equals 350,000 is true for most things, but not for volts across wet insulators in series.

The specifications would have to embody provisions such as these:

1. The individual unit must have a high wet flash-over, perhaps in the neighborhood of 70,000 volts.
2. There should be an extra high safety-factor against puncture. Each unit should withstand a puncture pressure equal to the line voltage.
3. The design must involve a reasonable certainty that puncture will never occur in service owing to the facilities afforded for quick relief by flash-over.
4. The string must withstand the heating effect of heavy arcing.

Motor-Driven Garbage Disposal Plant

An electrically operated garbage-disposal plant recently constructed in San Francisco converts refuse of vegetable or animal composition into useful commercial products. Grease is extracted and sold to soap-manufacturing firms, while the bones and vegetable parts are made into fertilizer. All operations in the plant from the time garbage is received until the converted product is shipped away are performed by individual-motor-driven apparatus.

Refuse is collected at night in 5-ton inclosed-tank-type motor trucks. On arriving at the plant the tanks, which are detachable, are hoisted to the top of the building by a motor-driven crane and dumped into steam-jacketed closed tanks, where the refuse is boiled for five hours. The mass is then compressed to extract the water and oil, which are afterward separated from each other by skimming. To drive off the remaining moisture in the solid matter it is fed through rotating boilers by helical screws.

From the boiler the mass is transferred on a conveyor to tanks containing gasoline, which absorbs all of the remaining oil and grease. By distilling the solution in a small refinery the gasoline is afterward reclaimed and used over again. The dried material, after being passed under powerful electromagnets to remove any nails or can covers, is pulverized and mixed with chemicals making a valuable fertilizer.

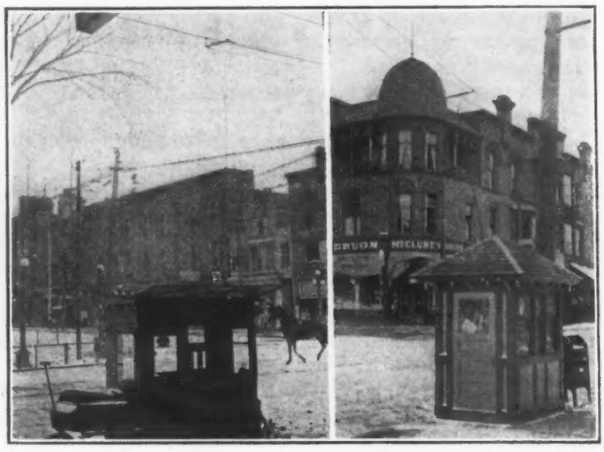
The disposal plant is exceedingly well lighted both inside and outside, 25-watt to 100-watt tungsten lamps being used and requiring in the aggregate about 5 kw. Energy for these lamps and for the 100 hp in motors is furnished by the Pacific Gas & Electric Company.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

No Customer Too Small at Warren, Ohio

As examples of the thoroughness with which the new-business department of the Trumbull Public Service Company has combed the city of Warren, Ohio, for electrical customers, the illustrations shown herewith are of interest. No user seems to have been too small to escape the attention of the company's active sales-



FIGS. 1 AND 2—CENTRAL-STATION CUSTOMERS AT WARREN

men. In reality, however, the portable lunchwagon, shown in Fig. 1, furnishes an even more attractive load than might be supposed at first sight, for on the exterior of this tiny shelter about forty 10-watt tungsten lamps have been installed. The interior is also electrically lighted. Not more than 50 ft. away a diminutive news-stand, built on the curb line, receives service over a similar connection. Energy for the lamps is taken from an overhead circuit through an improvised swinging connection, a wooden separator such as is often used in arc-lamp loops being used as an aerial cross-arm from which the service wires drop directly into the shelter. An attachment plug above the portable lunch wagon allows the circuit to be interrupted at this point when the owner is obliged to take his wagon temporarily to another location.

Where Individual Drive Would Have Saved Money

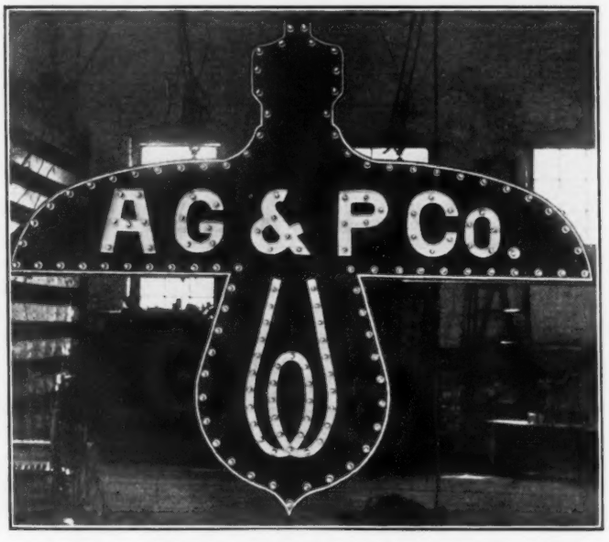
Lack of available funds sometimes prohibits equipping machinery with individual motor drive even when the economies effected by such installation would offset the first cost in a short time. But this reasoning should be modified when the use of line shafting necessitates the remodeling of a building to provide safe hanger supports.

In a certain old machine shop the use of individual motor drive was held to be impossible because of the expense, so line shafting was decided upon. As the building was old and showed signs of failure, it was found that 28-in. by 36-in. ceiling girders would have to be installed independent of the building to support the shaft hangers. Instead of reversing the original decision at this point and using individual drive, the steel work was installed at a total cost of $14,000, or about $215 per hp of shafting required. This short-sightedness in the use of funds can probably be attributed to the red tape which usually attends the issuing of requisitions from a purchasing department.

As has often been pointed out, line shafting costs money and involves a power loss in transmission of between 25 per cent and 40 per cent. Moreover, shafting detracts from the appearance of a shop, shuts off light, decreases the liability insurance rates, and requires considerable upkeep and attention. To operate one machine from a group-drive shaft the entire system has to be kept running, while with individual drive only the active machines require energy, thus eliminating considerable friction loss each day. With individual motors the output per machine attendant has in many cases been increased about 15 per cent to 20 per cent.

At the Sign of the Electric Lamp

Hanging in front of the office of the Alliance (Ohio) Gas & Power Company is an electric sign made in the shape of an incandescent lamp and reflector, which leaves no doubt in the mind of the observer as to the character of the business conducted within. The sign, measuring about 12 ft. from tip to tip, extends well out



ELECTRIC SIGN IN SHAPE OF INCANDESCENT LAMP

over the sidewalk and is easily the most striking display on the street.

Although inexpensive, the sign is equipped with 308 tungsten lamps operated by a home-made flasher. After having tried different flashing combinations, the filament, the lamp and reflector and the initials of the company are now first turned on separately, and

then finally the whole appears. Construction of the flasher has been made as simple as possible, the unit consisting of a small motor driving a bicycle wheel, to which is back-geared a drum carrying the copper contactors.

Removing Obstructions to Business

BY S. M. KENNEDY

In connection with the development of a motor load for a central station there are two fields for exploitation. The first is the selling of electrical energy for operating the plants of new enterprises, where the owners must decide whether they will use electric drive or generate

ENGINE PURCHASE

No.

District ..... Date .....

Owner ..... Location .....

Make of Engine ..... H.P. ..... In use ..... years

General Condition .....

Appurtenances Included .....

Price Asked by Owner .....

F.O.B. .....

If Engine is purchased we can obtain power contract for ..... years, for service to ..... H.P. Motors

Estimated Annual income $ ..... Monthly Min. $ ..... Cost of making Connection $

Transformers to be owned by Company ..... owned by Consumer ..... or lease to Consumer .....

THE ABOVE PURCHASE IS RECOMMENDED:

..... District Agent ..... Industrial Agent ..... Power Contract Agent

I consider the above mentioned Engine to be worth $ ..... F.O.B. ..... and that I can sell it for approximately that price.

Approved for purchase ..... 191 ..... Commercial Engineer

..... General Agent

POWER CONTRACT DEPARTMENT COPY

FIG. 1—FORM USED FOR PURCHASING ENGINES

their power by means of steam or gasoline engines. The second is the displacement of private plants by the installation of central-station service.

When an electric company has framed properly constructed schedules, adapted to the needs of each class of consumers, and the owners of new enterprises are approached in the right manner, there is usually not much difficulty in closing a contract for electric service, for in such cases no investment has been made by the prospective consumer in engines, boilers and like equipment. But the case is entirely different where there is a more or less effective installation to displace and an investment already made has to be discarded and in its stead the owner must consider the expenditure of new capital. The representatives of the electric company may be able to show the owner of the plant a decided saving in operating costs by means of central-station service, but frequently he must consider seriously the question of loss on present equipment and the additional investment involved in making a change, even though the change may be for the better. With many concerns this condition is the cause of long delay before electric service is finally installed, and private plants are often patched up and held onto long after the period of their normal efficiency has been passed.

The problem of finding means to hasten these changes is one with which many central-station managers have wrestled, and any plans toward this end which have proved successful are usually studied with interest. The longer the prospective consumer who owns a private plant delays in making the change to central-station service, the more it is costing him in unnecessary operating expenses and the more it is costing the electric company in loss of income. In many cases if the old plant were out of the way the change would be easy to make. Then comes the query, How much can the prospective consumer afford to lose on his old plant, in order to make the change to electric drive and how much can the electric company afford to pay in order to obtain the new business? In most cases of this sort, where the original investment is not too heavy, there is some plane upon which the two sides may get together and come to an understanding which will be mutually satisfactory.

Displacing Gasoline Engines

One of the larger companies operating in the West, whose lines cover a wide territory, has been working on a plan for the displacement of engines for the past two years, and the results achieved are reported to be highly satisfactory. In the territory covered there had been installed a great many engines burning gasoline and distillate, which operated fairly cheaply because of the prevailing low prices of these fuels. These engines were largely used in the cities and towns in driving the machinery of industrial plants and in the rural districts for operating pumping plants for water companies and private irrigating systems. Many of the plants were put in before the company's lines had reached the localities, and many others were installed in competition with electricity at a time when rates for service were not as favorable as at present. The gasoline or distillate engine has many advantages and has done excellent pioneer work, but it has its limitations. At times it will balk and kick and even refuse to go at all. As it becomes older it needs many repairs and replacements and usually causes much trouble to its owner. The easy operation of an electric motor is not overlooked by the owner of an engine, and usually he is not hard to convince that a change would be a good thing. But there is that engine which he already owns blocking the way. Along come the persuasive salesmen and practical engineer from the electric company! For the sake of convenience these public benefactors have classified the owners of engines as follows:

(a) The man who can afford to discard his present equipment and investment and forget it.

(b) The man who will install electric drive but likes to hold on to his present equipment for emergency purposes.

FIG. 2—ENGINES REPLACED BY MOTORS

(c) The man who will install electric drive and hold his engine equipment for sale.

(d) The man who would install an electric motor but must first sell his engine.

The first two classes take care of themselves as far as their old equipment is concerned, but the last two classes need special attention.

Buying Business

The company referred to discovered that a large income was being lost because many more or less feeble engines were standing in the road. Accordingly, a new department was organized and authority was given to tie up a portion of the company's working capital temporarily in the purchase of engines from owners who would use electricity. As a matter of fact, through this department the company was not purchasing engines—it was really purchasing business. The new department bought the engines as nearly as possible at their depreciated value and resold them as nearly as possible at the purchase price. The loss in turning them over was the price paid for the business.

The engine-selling department had two missions, namely, to sell engines on account of owners who had installed electric service and whose engines were held for sale and to resell engines purchased outright by the company. Engines were only purchased by the company when the business could be obtained by no other means.

The accompanying form was prepared, and on one of these every engine purchased had to be reported and approved. It will be noted that many features were taken into consideration in addition to the condition of

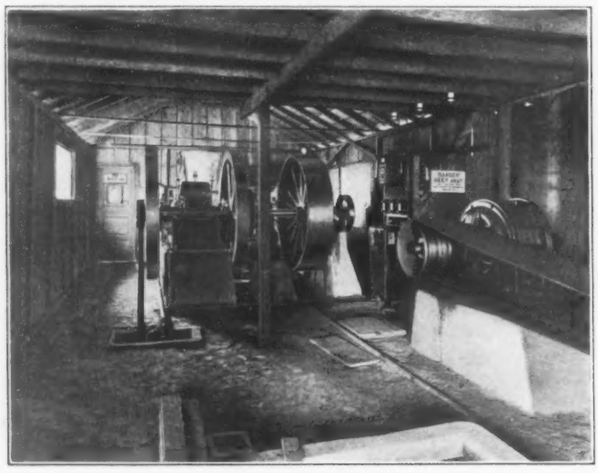


FIG. 3—MOTOR INSTALLATION SUBSTITUTED FOR OLD ENGINES

the engine and the price at which it could be purchased. The principal items were the income value of the business and the investment required to reach it. If these two details were harmonized, it was not a difficult matter to close an agreement covering the purchase of the engine and the installation of electric service in the plant of its former owner.

From March, 1912, to October, 1913, a period of nineteen months, the electric company purchased on its own account a total of 123 engines, with a combined rating of 3228 hp, for the sum of $34,183.83. In place of these engines purchased, the company contracted for service to approximately the same amount of horse-power in electric motors, with an estimated annual income of $64,920. Nearly all of the engines so purchased have been resold at prices which represent an average loss to the company of $22 on each engine, or, rather, that was the average amount paid by the company to buy the business—not a large amount when placed alongside the estimated annual income.

During the same period the company's engine department sold 137 engines on customers' accounts, the company acting solely as agent for the owner of the engine and making no charge for its services in bringing about the sale. The 137 engines sold for customers had a combined rating of 3796 hp. In their stead electric motors of a combined rating of 4044 hp were installed, and the estimated annual income to the company on these installations was $80,119. Summarized, the total sales of the engine-selling department for the period stated were 260 engines having a rating of 7029 hp. In their place, the company installed a like number of motors with approximately the same rating and representing a total estimated annual income for service equal to $145,039.

The foregoing figures do not cover all the engines displaced by the company for the period referred to. There were many others which were disposed of by their owners or held for emergency purposes. The sales mentioned were all made through the company's own organization.

Disposing of Old Engines

Engines purchased by the company are usually assembled in a warehouse provided for handling and selling them. Considerable care had to be exercised to see that all the parts and appurtenances were shipped in with each engine, otherwise deductions had to be made for missing parts when reselling. The average price at which the department aims to resell is on the basis of $10 per hp. All engines are sold for spot cash and no commission is paid in connection with any sale. The engine-selling department advertises engines for sale in papers which circulate in the communities it is desirable to reach. Advertisements are not inserted in the company's name. It not infrequently happens that a prospective purchaser of an engine who is on the company's lines will be induced to change his mind and sign an agreement for electric service to do the work an engine was originally intended to do. When a man calls to inquire about an engine the first question he is asked is where he wants to use it. If his location is beyond the company's sphere of influence, the negotiations proceed. If within the territory supplied with service by the company, the negotiations stop right there and then. No engines are sold by the department where the company's electric service may be obtained.

Where, then, are these engines resold? In the West there are many territories which are opening up into which no electric company has yet extended its lines. In such fields power is needed for development work, and the gasoline engine temporarily meets the requirements. The engine department finds a steady demand for certain sizes and types of engines and has little difficulty in making sales. Sometimes a resold engine may get under the lines of some other company in a distant field, but such sales are not encouraged. Those in charge of the engine department cannot know exactly where each engine is to be installed, but they do know that each engine sold goes away from the particular territory supplied by the company, and to the best of their ability the engines are steered toward territory where electric service is not available.

Cold Storage of Food-Stuffs

By Sydney F. Walker

In adjusting the temperature of cold-storage compartments the greatest care must be taken to obtain temperatures appropriate for the particular foodstuffs preserved. Some substances may be actually frozen, while others must not. Beef, for instance, may be frozen, but it commands a higher price if it is only chilled. For retail butchers' use such chilling is usually sufficient. Fruit must not be frozen. Fish, on the other hand, should be subject to a special method of

freezing, being first allowed to assume the condition of "rigor" and then subjected to a low temperature, though not actually frozen. If it is subjected to a low temperature before the rigor sets in, it will not keep well, and if the rigor is allowed to pass before the low temperature is applied it will not keep at all.

One should also constantly remember that cold storage will not make bad produce good. Cold storage will preserve the qualities of good produce, but it is not every kind of fruit that can be cold-stored. Not every apple, for example, is suitable for such preservation. Nearly every kind of soft fruit has been kept in cold storage with success, but so far as the writer is aware tomatoes have never been successfully handled in this way.

New Business Activities at Canton, Ohio

A canvass to discover the number of customers already using electric service and the number of "prospects" available has just been completed by the new-business department of the Canton (Ohio) Electric Company. With the data obtained from this canvass as a basis, the company is now circularizing the prospective customers besides inaugurating both a better-lighting crusade and an electric-sign campaign.

If it is possible to secure the co-operation of Canton manufacturers using central-station service, each will be asked to exhibit his particular line of manufactured products in the electric-service company's windows for one week. As Canton is the home of many factories, these window displays promise to be both interesting to the passing public and profitable to the central station. Mr. R. E. Lane is in charge of lighting solicitors in the company's contract department.

Central-Station Service in New Chicago Hotel

The newest of the large "downtown" hotels of Chicago is the Fort Dearborn Hotel, at the corner of West Van Buren and South LaSalle Streets. This hotel was opened on March 23. The building is eighteen stories

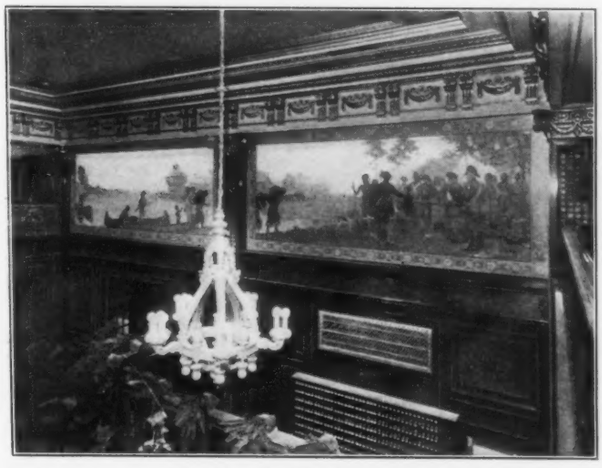


FIG. 1—CONCEALED LIGHTING OF MURAL PAINTINGS

high and contains about 500 rooms all with private baths or lavatories. With equipment the hotel is said to have cost $1,250,000. It is operated by the Hotel Sherman Company as a moderate-priced hotel built in accordance with modern ideas.

Electricity for this hotel is supplied by the Commonwealth Edison Company. About 5200 25-watt tungsten lamps are required for lighting, in addition to about 600 10-watt lamps used in electric signs and decorations. There are three electric passenger elevators, as well as a freight elevator and a service elevator running from the kitchen to the main dining room on

FIG. 2—BARBER SHOP, SHOWING LIGHTING FIXTURES

the mezzanine floor. The total rating of electric motors used to operate these elevators is 140 hp. Electric motors used for general purposes are rated at 110 hp, so that the total rating of motors in the establishment is 250 hp. Direct current is used.

On the first and second floors there are a number of artistic lighting fixtures, all of which were furnished by the T. W. Wilmarth Company, of Chicago, which specializes in hotel lighting fixtures. The entrance is on South LaSalle Street, fronting the LaSalle Street station of the Lake Shore and Rock Island railroads. A marquise over this entrance is outlined in electric lamps. Indirect lighting is employed in the barber shop.

In the sub-basement the mechanical equipment consists of high-pressure boilers for steam heating and for supplying steam to such of the pumps as are steam-driven. There are also vacuum pumps for cleaning purposes, a modern refrigerating plant and complete air-washing and ventilating apparatus. The elevator machinery is also placed in the sub-basement.

In the passenger elevators a special safety feature is provided. There is a door in one side of each car, which can be opened by the operator, giving access into another elevator in the adjoining shaft in case of accident by which a car may be caught between floors.

The bedrooms are provided with a central-dome lighting fixture, and beside each bed is a small stand carrying a reading lamp. This stand also serves for the telephone. Above each dresser are two bracket fixtures with pull-chain sockets, and there are also similar bracket fixtures above the mirror in the bathrooms.

All the ventilating fans are electrically driven. The ventilating system has been made as flexible as possible in order to be adjusted to varying conditions of outside weather and temperature and also to provide for economical operation.

Mural paintings in the lobby and bar-room of the hotel add an artistic feature. They represent scenes about old Fort Dearborn at the mouth of the Chicago River, after which the hotel is named, or they have to do with historic incidents in the history of Chicago. Special concealed electric-lighting arrangements are employed with excellent effect for the illumination of these paintings.

Illumination and Wiring

Electric Lighting of the Lynn Shore Boulevard

Electricity has superseded gasoline in the illumination of the famous ocean boulevard at Lynn, Mass. With the change this spacious drive and promenade has achieved a marked increase in popularity. The stretch of boulevard from Washington Street to Monument Square was formerly lighted by forty-four double-unit Welsbach gasoline lamps of the mantle type carried 12 ft. above the street surface on posts 11 ft. high. These gas lamps were rated at about 30 cp each, but the illumination between adjacent pairs of lamps was so dim that it was impossible to take a photometer reading at the mid points. In place of these units there have now been installed twenty-eight 320-watt, 4-amp General Electric ornamental luminous-arc lamps placed at distances of 250 ft. to 300 ft. apart and elevated 18 ft. above the boulevard surface. The distance from Washington Street to Monument Square is about 1.5 miles.

FIG. 1—LUMINOUS-ARC LAMP

The boulevard is under the jurisdiction of the Metropolitan Park Commission of Boston and has a tarred macadam surface with driveway 40 ft. wide, an intermediate planting space 30 ft. wide and a 15-ft. promenade flanked by a seawall. The new lamps are carried on Lundin fluted poles and are supplied with energy by cable run in underground conduit. Inside each pole 15 ft. of duplex No. 10 cable was installed, and in addition to the lamps used on the above section of the drive twelve others were erected in the district adjacent to the state bath house. Five of the latter are to be burned from dusk until midnight between June 1 and Dec. 1, and the remainder of the lamps are to be burned nightly from dusk to dawn throughout the year. The bases and tops of the poles are of iron, the shafts being of wood in accordance with the Massachusetts statute. In the entire installation 9435 ft. of conduit and 10,413 ft. of No. 8 underground cable were used. The Lynn Gas & Electric Company defrayed the cost of installation, and charges for all-night service at the rate of $90 per lamp per year. This is about 20 per cent less than the corresponding cost of operation with the gasoline lamps, which had to be filled daily by a ladderman.

Illuminometer measurements taken down the center line of the drive with the former gas lamps in service gave readings averaging 0.03 ft.-candle opposite the lamps on the edge of the drive and 0.01 ft-candle opposite lamps placed on the promenade. With the present electrical installation readings of 0.37 ft.-candle are obtained opposite the lamps at the center of the drive, and 0.018 ft.-candle half-way between the lamps. Additional tests on the promenade show 0.8 ft.-candle opposite the lamps and 0.027 ft.-candle at points half-way between. In other words, twelve times the former illumination is obtained by the present arc lamps.

The underground conduit construction was greatly facilitated by close attention to the organization of the force, and in the first ten days after the job was started the following work was done: Turf cut and removed. trench dug, conduit laid in trench, drawing-in wire pulled in, joints of conduit cemented, concrete foundations for bases poured, cable drawn in with windlass, and tripod and bases set and leveled. The poles are set on concrete foundations about 18 in. deep. Harrington drive joints are used in the conduit, which is of the single-duct type. The bases of the posts are grouted to the foundation by cement. The pole shafts were erected by a tower wagon. The trench dug was about 1 ft. in width by 18 in. in depth, the turf being cut by a home-made cutter illustrated on the opposite page.

The tool mentioned consists of a hinged frame pivoted at the bearings of two edged wheels of iron plate 1 ft. in diameter, the frame being 3 ft. 6 in. long, 18 in. wide and operated by two men. When not in use the handles are folded. With one line of the proposed trench laid out, the turf can be cut with great speed by pushing the cutter along the trench location with one wheel following the line. Since the completion of the new lighting much appreciation of the improved illumination has been expressed by drivers. Popular enjoyment of the surf on the beach has been enhanced, since under the old arrangement the beach was at night ordinarily too dark for enjoyable bathing or for the purpose of those who like to watch the breaking surf.

FIG. 2—NIGHT ILLUMINATION OF THE LYNN SHORE BOULEVARD

FIG. 3—SHORE DRIVE LIGHTING, SHOWING REPLACED GAS FIXTURES, LYNN SHORE BOULEVARD

FIG. 4—TURF CUTTER USED IN TRENCHING, LYNN SHORE BOULEVARD

Springfield (Mass.) Street-Lighting Rehabilitation

Prof. Harry E. Clifford, of Harvard University, has been retained by the city of Springfield, Mass., to work out a comprehensive plan of illumination for the municipality in connection with the expiration on May 1 of the present street-lighting contract with the United Electric Light Company. Preliminary studies indicate that magnetite-arc lamps installed on poles of French architectural design will be used extensively. Special attention will be given to the lighting of the down-town district in the vicinity of the new Municipal Group and to the illumination of residential sections by incandescent lamps carefully adapted to the local requirements.

Wiring Already-Built Houses in St. Louis

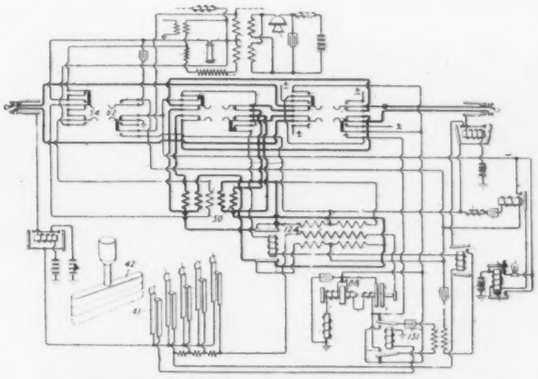
By means of newspaper advertising and circularizing, as well as by personal solicitation, the Union Electric Light & Power Company, of St. Louis, is pushing with energy a campaign to bring about the wiring of "already-built" houses. It announces that the owner can make a start by wiring five rooms on the same floor of his "already-built" house for a sum as low as $17.95, and this may be paid one-tenth when the work is completed and the remainder in twelve monthly instalments. The company has issued an interesting illustrated pamphlet on the subject. With the prefatory remark that the probable reason why the owner of a house does not enjoy the benefits of electricity is because the dwelling was built before electricity had been brought within the reach of the masses of the people, as at the present time, it is pointed out that the wiring will not injure the house, while the benefits and pleasures of using electric lighting and electric appliances are described. Representatives of the company will call on the householder in the evening if desired. A schedule of prices for wiring is given, and these are the actual prices charged by the electrical contractors of St. Louis for doing the work. The company does not add anything to cover interest, labor, advertising or other expenses. The whole of the "personal letter" sent out by the company and bearing a fac-simile of the signature of Mr. F. D. Beardslee, who is the sales manager, is couched in most convincing language, and it is not strange that excellent results are being obtained from this intelligently conducted campaign.

Recent Telephone Patents

Mr. J. G. Blessing, of Chicago, has patented an improvement in automatic systems which consists of combining in one apparatus both a slow-acting and a normal relay. This relay differentiates the quick impulses of the moving sender dial from the slower or longer impulse of the dial when coming to rest. The patent for the system including this improvement is assigned to the Automatic Electric Company.

Repeater Circuit

A complete circuit system for a two-way repeater is described by Mr. H. E. Shreve, of Millburn, N. J., in a patent granted to him and assigned to the Western Electric Company. Provision is made for a supervising telephone instrument and a means for adjusting the apparatus as indications in this supervising receiver demand. The repeater is arranged in a cord circuit as shown in the cut, the repeater being shown at 88. At 124 is shown the repeating coil, through which the repeater acts in the opposite direction. At 50 is a repeating coil dividing the line into two sections for the purpose of repeating. This coil has an extra winding ex-



TELEPHONE REPEATER SYSTEM

posed to the coils of both line sections. If the receiver is connected to this winding by the key at 54 interference will be ascertained by means of the receiver. The key at 42, with its co-acting springs, serves to adjust the disturbance by changing the power of the repeater, by inserting resistance and by reversing the polarity of the repeater. The slider of the key has two heights. With one height the resistance spring alone

is affected, and with the other the reversing springs at 41 are also moved. The reversing springs affect the relays at 131 which make the reversal. At 62 a "talk-and-listen" key is provided, the throwing of which automatically cuts out the repeater.

Letters to the Editors

The Low-Priced Electric Vehicle

To the Editors of the Electrical World:

SIRS: I cannot agree with the conclusions of Mr. John H. Hertner, whose communication was published in the *Electrical World* of Feb. 21, that no demand exists for a low-priced electric vehicle. Such a condition may obtain in Cleveland, but for every city of the size of Cleveland there are twenty-five whose population does not exceed 2500 to 5000 people and in which the average resident lives upon an income of about $1,500 per annum—in other words, the class of people which has been buying Henry Ford's low-priced gasoline car.

Mr. Hertner says that the motor-car purchaser has a tendency toward speed mania. This may be true of the people who have been buying and are buying gasoline cars, but how about the large number who have not been buying gasoline cars and would still like to have a motor car and are able to support one? This class includes the wives and half-grown daughters of Mr. Hertner's alleged speed maniacs, and also another group of still greater value to the one-man electric plant. The group referred to embraces the small-town merchant who has to support one or two delivery wagons and is enterprising enough to acknowledge the superiority of motor delivery over horse delivery. I have no doubt that there are hundreds of small-plant managers like myself who have felt the electric vehicle proposition to be absolutely hopeless in their towns. We have sold one 3000-lb. truck in this territory and may sell two or three more. Three different "prospects" who formerly simply ridiculed the idea of an electric delivery wagon whenever it was broached to them at once "sat up and took notice" of Mr. Ford's proposition. In fact, one of them happened to call my attention to the original announcement in a daily newspaper several days before I received my copy of the *Electrical World* with its confirmation of the facts.

Therefore, I repeat, there is a market, and a very attractive one at that, for a low-priced electric vehicle, and I have faith that Mr. Edison and Mr. Ford between them will give us a dependable car. The same thing was said when the low-priced Ford gasoline car was put on the market, yet I find that over 35 per cent of the gasoline cars in this territory are Ford cars.

H. G. OVERBECK,
General Manager Glenwood Light & Water Company.

Glenwood Springs, Col.

Low-Priced Electric Cars

To the Editors of the Electrical World:

SIRS:—Mr. John H. Hertner in his letter published in the Feb. 21 issue of the *Electrical World* showed the attitude of electric pleasure vehicle manufacturers toward low-priced cars. Perhaps the views of a central station serving a total population of 325,000 people would not be out of place, especially at this time when there seems to be some prospect of such a car being produced.

In Providence and vicinity conditions are quite different from those in the Middle West, with which Mr. Hertner is perhaps more familiar. We not only have a field for a good low-priced electric runabout, but we have learned of at least five customers that are waiting to purchase an Edison-Ford as soon as such a car is available.

It may be true that an electric coupé should sell for $2,000 and upward. Such vehicles represent high-class coach work and can be compared only with gasoline vehicles of the better class. A two-passenger runabout represents quite a different proposition. Such a vehicle may be very light, and in this way the cost of tires, batteries, motors, etc., can be considerably reduced. It should be possible to produce a runabout capable of making 60 miles at 20 miles per hour over ordinary hilly country roads and to place it on the market complete with a 40-A-4 Edison battery at a price not exceeding $1,050. It should also be possible to sell the above car without battery at a price not exceeding $500, and there might be an advantage in allowing the customer to purchase the type of battery best suited for his particular needs.

Providence, and, in fact, New England in general, is waiting for such a car. Our territory abounds with gasoline limousines which are owned by a class of people who would not consider driving their own cars. The electric coupé would not fill their requirements in any case, even were it possible to secure the necessary high speed and mileage which they desire. Professional men usually own only one car and feel the need of a gasoline coupé capable of long mileage at high speeds. Both classes could own to advantage a light, inexpensive electric runabout and by the use of such a vehicle could eliminate a great deal of useless wear on the larger and more expensive gasoline car. It would be the extra car for general family use on all except social occasions, and would be much better adapted for short trips about the city.

Such people do not care to spend upward of $2,000 for an electric roadster, as the mileage and speed obtained from such vehicles does not satisfy them. At a reasonable price they would purchase an Edison-Ford.

It is, of course, true that low-priced gasoline vehicles are now purchased by those who can afford to own only one car. Mr. Hertner feels that electric vehicles would not satisfy them, regardless of what price they might be sold for. Perhaps he is right. Personally, I feel that if Mr. Ford were to produce a low-priced electric runabout he might decide to operate these vehicles on the battery-exchange basis so that every owner of an Edison-Ford might for a very nominal sum exchange an exhausted for a fresh battery at any Ford agency. Our own company would be glad to sell energy at a very low price to the local branch should it wish to take up such a proposition.

Our lighting and motor-service customers seem to demand such a car, and the fact that they will not buy second-hand "Stanhopes" of the vintage of 1907 does not disprove this statement. We try not to expect too much of the electric pleasure vehicle manufacturers, but it would please us to know that they are at least inclined to produce a lower-priced vehicle, which up to the present time has not seemed to be the case. Our company has co-operated with the vehicle manufacturers and with the Electric Vehicle Association of America both toward their advertising fund and in many other ways. We shall continue to do all this, and perhaps more, but it would really seem as if the electric vehicle manufacturer should not try to prevent the production of a successful low-priced electric vehicle, as, from the central-station standpoint, this seems to be the only way in which this branch of the business can be developed at a profit.

H. H. SKINNER,
Narragansett Electric Lighting Company.

Providence, R. I.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

A 675-hp Diesel-Engine Plant as Adjunct to Hot-Water Heating System

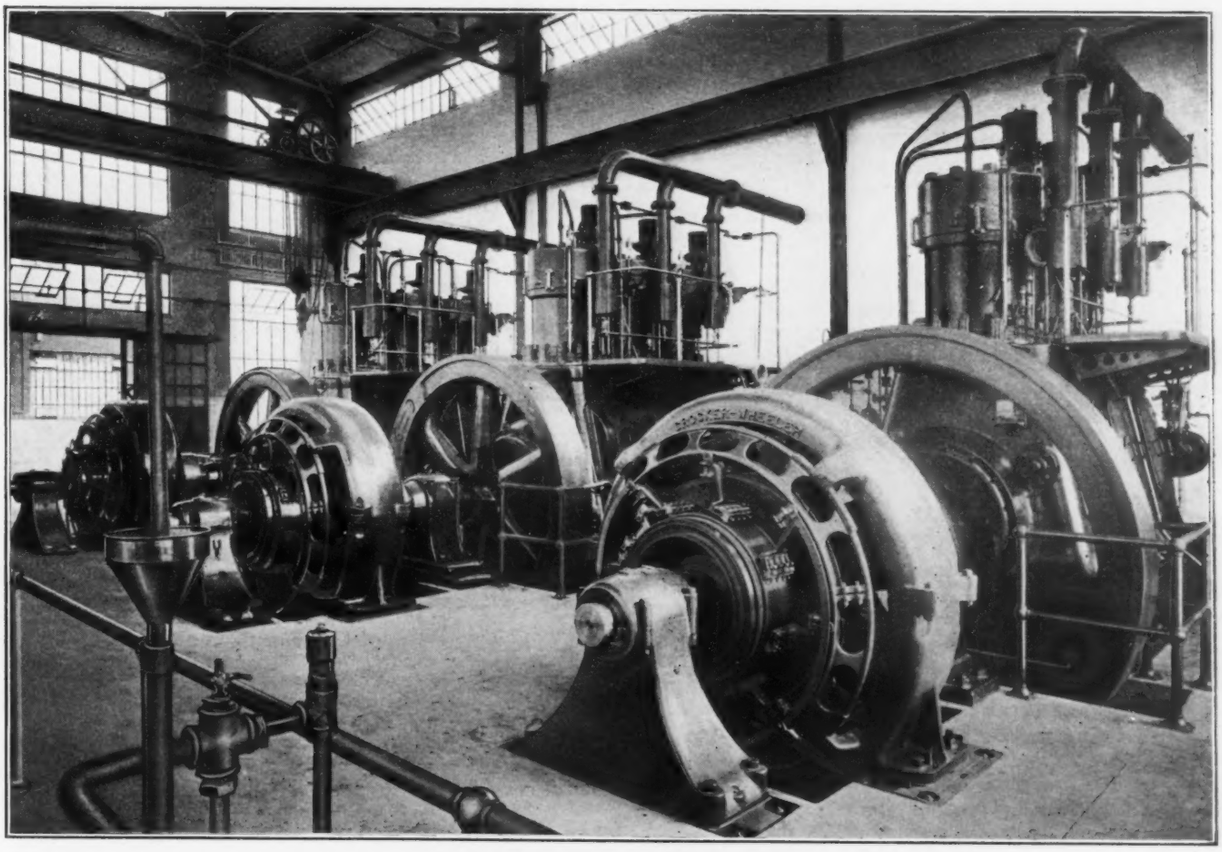
Three four-stroke-cycle 225-hp Diesel internal-combustion engines comprise the present prime-mover equipment in the generating station at the new factory of the Busch-Sulzer Brothers Diesel Engine Company, St. Louis. The ultimate rating of the station, as it now stands is, however, 900 hp, space having been provided for the future installation of a fourth similar engine set. Each of these three-cylinder engine units weighs 90,000 lb. and occupies a space 23 ft. long by 9 ft. 6 in. wide by 12 ft. high.

Two 12,000-gal. fuel-oil storage tanks buried outside the power house near an adjacent railroad siding furnish oil to the engines through pipe lines laid underground. Oil flows by gravity to these storage reservoirs from tank cars on private railroad sidings. Inside the power house this oil is put under pressure and sprayed into the engine cylinder when the piston has completed its compression stroke. This spraying action is sustained over 12 per cent of the working stroke of the piston, the resulting combustion being gradual and not explosive. The engines are started by means of compressed air.

Directly connected to each of these three-cylinder oil engines is a 160-kw, 115/230-volt, three-wire, direct-current Crocker-Wheeler generator operating at 164 r.p.m. Between each engine and generator a 7.5-ton, 9.5-ft. flywheel is mounted, steadying the action of the engines and helping the generators carry instantaneous peaks caused by the starting of large machine tools.

From the generator leads are taken to the seven-panel switchboard which stands about 8 ft. from the north wall of the power house. One panel has been provided for each generating unit and the remaining four panels control the shop motor and lighting circuits. Two air compressors, the cylinder dimensions of which are 10 in. by 6.5 in. by 3 in., are also installed in the station. These units, each belt-driven by 50-hp, 230-volt motors operating at 600 r.p.m., supply air under high pressure for starting the engines and injecting the fuel oil into the cylinders of the engine units in operation. The air-storage tanks stand along the south wall of the room. The entire engine room is served by a 10-ton Whiting hand-operated traveling crane.

In this power house there are two separate systems of water piping. One of these circulates hot water for the heating system, while the other carries cold water to the cylinder jackets of the oil engines. In the latter system water travels by gravity from the roof tank down through the water jackets of the engines, and is



THREE 225-HP DIESEL-ENGINE SETS

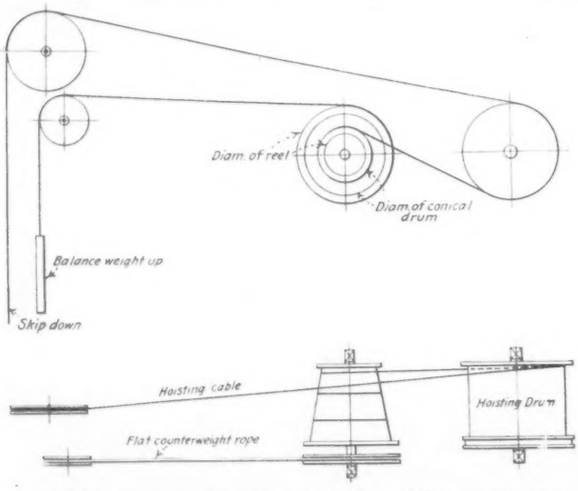
then collected in a 6-in. main and delivered to a motor-driven water cooler. This device, which is something of an innovation, consists of a cylindrical drum, 4 ft. in diameter and 8 ft. long, driven at 6 r.p.m. by a 5-hp, 230-volt motor. The lower side of this cylinder is always immersed in the water returned from the jackets. As the drum revolves it takes up a thin film of water and exposes it to air circulated through the cooler and escaping through a stack. From the rotating cooler the jacket water returns to a concrete jacket-water reservoir to be lifted by motor-driven pumps to the roof tank.

The internal-combustion engines play an important part as pre-heaters for the hot-water heating system which supplies warmth for the factory and office buildings. Gases collected in the exhaust manifolds are conducted into heaters in the boiler room, and water returning from the heating mains is circulated through these gas heaters before entering the steam heaters at the west end of the boiler room. Three 100-hp boilers generate steam at 100-lb. pressure, supplying the hot-water heaters and the steam hammers in the forge shop.

In round figures, the connected motor load of the factory is 1500 hp, the total number of motors being approximately 250. These machines range in rating from a fraction of a horse-power up to 50 hp.

Balancing of Cables for Deep-Shaft Hoists

When electric hoists are operated in shafts more than 3000 ft. deep the weights of the hoisting and counterweight cables become considerably unbalanced and the useless load on the motor is accordingly increased. To compensate for this unbalanced condition the method illustrated herewith may be employed. The hoisting cable passes around the hoisting drum and thence around a conical drum terminating at the smaller end. The counterweight is supported by a flat rope which is wound on a single width reel attached to the same shaft as the conical drum. The conical drum and reel may be designed so that the total travel of the counterweight



METHOD OF COUNTERBALANCING IN 3000-FT. SHAFT

is less than that of the cage, thereby avoiding the necessity of raising the counterweight entirely to the surface, where it may freeze to the guides in severe winter weather. The operators of the Penn Iron Mines, Vulcan, Mich., where this scheme is employed, recommend that the counterweight exceed the weight of the cage by 800 lb. so that the descending skip will always overhaul the drums. When thus counterbalanced, the loss, neglecting friction, is only about 6.6 per cent of the total energy required to raise a 12,000-lb. cage, as compared with 50.6 per cent when the cables are not balanced.

Cause of Wrecking of Remote-Controlled Motor

While waiting for the delivery of a centrifugal pump which was to be connected to a 30-hp, 110-volt compound-wound motor, we temporarily connected the motor to a small triplex pump rated at about 8 hp or 10 hp. One day, while operating at this light load and without any warning, the motor was completely wrecked. The brush holders and commutator segments were found about 50 ft. away from the machine and the front bracket was broken. The motor was installed about 575 ft. from the control apparatus and was connected thereto by No. 2 stranded-wire feeders and No. 8 solid-wire field circuits. Is it possible that the commutator exploded and caused the damage? G. G.

The damage was probably caused by the interruption of the shunt-field circuit of the machine with the full 110 volts impressed across the armature. When a break occurs in the field circuit of a direct-current motor (a condition which could easily be brought about by an interruption of your No. 8 line or any of the auxiliary apparatus connected thereto) the current taken by the motor would be limited largely by the resistance of the No. 2 transmission line, 575 ft. in length. As this line has a resistance of say 0.2 ohm, the current could not exceed 550 amp and was probably considerably less. With the shunt-field circuit open the tendency of the machine would be to increase its speed enormously under light load. Probably what happened was that the load allowed the speed to increase until the commutator was thrown apart by centrifugal force.

Temperature Rise of Induction Motor at No Load

We have converted a 20-hp, twenty-five-cycle, three-phase, 550-volt induction motor into a 630-volt machine by rewinding the stator with wire a size smaller and an additional turn per coil. At no load the stator temperature rises from 20 deg. C. to 70 deg. C., while at half load the temperature rises only 5 deg. further after three hours' run. Please explain the cause of heating at no load and state whether 70 deg. is a safe temperature at which to operate a motor. G. W. H.

The power-factor of an unloaded induction motor is usually very low and the primary current required to operate it is almost as large as the full-load current, so that heating is not materially different in the two cases. The temperature rise which you quote is not excessively high, 75 deg. C. usually being considered the maximum temperature limit at rated load. It may be possible that one additional turn per coil is not sufficient for the increased voltage and that the magnetizing current is unnecessarily large.

Changing Range of Power Indication

We have a graphic wattmeter which is now capable of recording a maximum of 320 kw when connected to a two-phase circuit through sixteen-to-one series transformers and twenty-to-one shunt transformers. How should the series transformation ratio be changed so that a standard 600-kw chart may be used? H. M.

To give full-scale deflection with any chart the power input must be the same for a given graphic wattmeter. The only factor which has to be changed when a different range chart is desired is the meter constant, or product of the series and shunt transformer ratios. To use a 600-kw chart instead of a 320-kw dial, the series transformation ratio will have to be increased in the same proportion provided it is a constant-potential system. Thirty-to-one series transformation will therefore be required with the new chart.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

General Transformer. — KARL PICHELMAYER. — A mathematical paper on the theory of the general transformer in its relation to the theory of the ordinary transformer.—*Elek. u. Masch.* (Vienna), March 8, 1914.

General Transformer.—F. NIETHAMMER AND E. SIEGEL.—A further mathematical paper on the transformation ratio of the currents in the general transformer.—*Elek. u. Masch.* (Vienna), March 15, 1914.

Ventilation.—An illustrated article by R. E. Gilman on the essential factors of ventilation of rotating electrical apparatus with illustrations of some of the methods employed in specific cases. In a second article W. W. Stevenson describes the apparatus used for cooling and cleaning the air supplied to two 6000-kva turbogenerators.—*Elec. Journal,* April, 1914.

Lamps and Lighting

Half-Watt Lamp.—H. REMANE.—The author discusses briefly the fundamental principles of the nitrogen-filled tungsten lamp. The osram half-watt lamp is now being made commercially in Germany in the following sizes: 300 watts, 600 cp, 50 to 60 volts; 500 watts, 1000 cp, 100 to 130 volts; 1000 watts, 2000 cp, 100 to 260 volts; 1500 watts, 3000 cp, 100 to 260 volts. Diagrams are given showing the distribution of the light from such lamps with and without special reflectors.—*Dingler's Polytechn. Journal,* Vol. 329, No. 4, 1914.

Arc-Lamp Electrodes.—A note on a recent British patent of H. Ayrton (No. 1775, 1913) for negative arc-lamp electrodes. A central core of hard carbon is surrounded by a shell, burning more easily. A closely adhering copper coating is provided.—London *Elec. Eng'ing,* March 26, 1914.

Invisible Light.—W. R. WHITNEY.—Some brief notes on invisible light in which the author answers a few of the most frequently asked questions about the radiations given by X-ray tubes and radioactive material. Some of the more important characteristics of the electron are cited and its behavior in different media is stated briefly. The similarity and difference between the emissions from radium and X-rays are touched upon.—*Gen. Elec. Review,* April, 1914.

Generation, Transmission and Distribution

Current-Limiting Reactors.—An article by J. N. Mahoney on the effect of limiting reactors on the application of oil circuit-breakers; an illustrated article by J. F. Peters on the construction and design of such reactors; an article by W. M. Dann on the mechanical stresses in the coils. In a further article by F. D. Newburg, W. M. Dann and J. N. Mahoney on generator, reactor and circuit-breaker performances under short-circuit conditions, a full account is given of special tests made primarily to observe the behavior, under actual short-circuit conditions, of current-limiting reactors designed for feeder circuits.—*Electric Journal,* April, 1914.

Electric Supply for the Eastern Provinces of Germany.—BARTEL.—An illustrated article on a proposed system of electric supply for three eastern provinces of Germany. It is estimated that Östpreussen needs 60,000 kw, Westpreussen 55,000 kw and Posen 60,000 kw. It is shown that it is out of the question to utilize water-power for this purpose. For Östpreussen and Westpreussen peat is the logical fuel and for Posen lignite. A few large power plants are suggested and an estimate of their cost is given.—*Elek. Kraftbet. u. Bahnen,* Jan. 24 and Feb. 4, 1914.

Electric Hoist.—K. A. PAULY.—An article discussing the advantages of the electric hoist over the steam or air hoist. In the introduction the author points out the fact that since electricity can be far more economically distributed than steam or compressed air it is best adapted to be the motive power in mining. This is especially true when the shafts are widely separated, for individual power-generating stations at each shaft are to be avoided for obvious reasons. Attention is then called to the very low operating efficiency of steam and air engines when carrying such a fluctuating load as a hoist. A full description of the systems of electric drive of hoists then follows; this covers the salient points of safety, reliability, cost of operation and first cost. A table of calculated operating costs of the three kinds of hoist drive, covering a wide range of power and fuel costs, is furnished; and an analytical discussion of this table closes the article.—*Gen. Elec. Review,* April, 1914.

Traction

St. Gothard Railway.—G. BRECHT.—The Board of Management of the State Railways of Switzerland has adopted the plan of electrifying a part of the St. Gothard railway. It has been decided that the State should itself erect and operate power plants for the road. The section from Erstfeld to Bellinzona is to be electrified first; it has a length of 110 km (67 miles), of which 28 per cent is tunnel, and it has grades up to 27 per cent. There will be two power plants at Amsteg and Ritom. The speed of the trains is to be considerably increased. The fifteen-cycle, single-phase system will be employed, but no definite decision has been reached as to details. The trolley pressure will probably be 7500 volts for the first section with its many tunnels, but when the electrification has been extended to other sections a pressure of 15,000 volts will be used on the extensions. It is estimated that the annual cost of electric operation will be $1,225,000, against $1,277,500 for steam operation. Electric operation is, therefore, estimated to yield a saving of $52,500 per year. The cost per kilowatt-hour supplied to the locomotives is estimated to be 1.03 cents. The two power plants will be equipped with 8000-hp, 8000-volt generators. For transmission 60,000-volt cables will be employed. For the return current the rails are to be used, connected to a special return circuit. At present electric locomotives will be used throughout, but when the electrification is extended to Lucerne motor cars will also be employed. The high-speed locomotives will be rated at 3000 hp each and will be run at speeds up to 90 km (54 miles) per hour.—*Elek. Kraftbet. u. Bahnen,* Feb. 24, 1914.

Storage-Battery Motor Cars.—M. BÜTTNER.—There are at present in use about 200 storage-battery motor

cars on trunk railroads in Germany. This includes 176 motor cars on the Prussian-Hessian state railways. A sketch is given of the development of the storage-battery motor car and the results obtained with it are said to be quite satisfactory.—*Elek. Kraftbet. u. Bahnen,* Jan. 4, 1914.

Automatic Signals.—G. KEMANN.—The conclusion of his very long, detailed and profusely illustrated report summing up the preliminary studies made for the introduction of the automatic signal system on the Berlin elevated road and subway.—*Elek. Zeit.,* March 26, 1914.

Installations, Systems and Appliances

Birmingham.—An illustrated article on recent extensions of the electric supply department of Birmingham, England. The supply started in 1889. There is a supply of direct current on the three-wire system at 440 volts for lamp and motor circuits, a direct-current supply at 550 volts for traction, and a three-phase supply at 5000 volts for transmission to the outlying districts, where it is transformed to direct current on the three-wire system at 440 volts for lighting and industrial purposes and to direct current on the two-wire system at 550 volts for traction. The total rating of the station is now 36,500 kw. The last two machines installed were 5000-kw turbo-alternators.—London *Electrician,* March 27, 1914.

Bristol.—An article illustrated by diagrams showing the gradual increase of electricity supply in Bristol, England. The supply was begun in 1892 and a diversified demand exists for industrial, commercial and residential supplies. Three distinct systems of distribution are in operation, single-phase at 210 volts and 105 volts, ninety-three cycles; direct-current at 500 volts and 250 volts, and three-phase at 365 volts, fifty cycles. A series of diagrams showing the gradual development of the business emphasizes a relatively large drop in cost in 1913-14 due to an abnormal increase in energy sold. A considerable acceleration of growth has marked the last three or four years, and this is thought to be the result of the inauguration of an active sales department.—London *Elec. Times,* Feb. 5, 1914.

Electric Heating and Cooking.—Profusely illustrated notes on recent progress in the use of electric heating and cooking in the West End of London. From the results obtained in twenty-one typical electric cooking installations it is stated that the average cost per person, when charging 1 cent per kw-hr., works out at 2.2 cents per day.—London *Elec. Times,* Feb. 19, 1914. Illustrated notes on progress of electric cooking at Derby are given in *Elec. Times,* Feb. 26, 1914. Various special new commercial heating appliances with reference to exposed grill elements versus protected grill elements are given in London *Elec. Times,* March 5, 12 and 19, 1914.

London.—An editorial on proposed schemes of amalgamating the different London electricity supply companies into one company.—London *Electrician,* March 20, 1914. Various notes on the same subject in London *Elec. Times,* Feb. 12, 26, March 5, 12, 1914.

Sheffield.—The conclusion of the illustrated article on electricity supply at Sheffield, describing the new extensions under way at the Neepsend station, the equipment of substations and the rates charged consumers.—London *Electrician,* March 20, 1914.

Protective Resistances.—BRUNO BAUER.—A theoretical article on the use of series protective resistance in connection with high-tension oil switches.—*Elek. Kraftbet. u. Bahnen,* March 14, 1914.

Electromagnetic Brakes. — ERNST SCHWARZ. — A mathematical article on the calculation of electromagnetic brakes for cranes and hoists.—*Elek. u. Masch.* (Vienna), March 18, 1914.

Electrophysics and Magnetism

Magnetic Properties of Iron When Shielded from the Earth's Magnetism.—A note on a recent (British) Royal Society paper by E. Wilson in which the author stated that when iron is subjected to a considerable magnetizing force a species of polarization is produced which has the effect of reducing the permeability and increasing the dissipation of energy due to magnetic hysteresis for given values of the magnetic induction. The residual effects can be removed by careful demagnetization or annealing. It was thought by analogy that the earth's magnetic force would also have a polarizing influence upon exposed iron, and this was the subject of the present paper. An effort was made to remove the residual effects of the earth's magnetism by placing the specimen, which was of ring form, in a magnetic shield and carefully demagnetizing it. The magnetic properties of the material were then examined in the usual manner with a ballistic galvanometer, and a comparison was made with those obtained from the exposed or unshielded specimen. It was found that the permeability of freshly demagnetized and shielded iron, corresponding to a given value of the magnetic induction, was considerably larger than in the case of the unshielded specimen. In stalloy the ratio of the permeabilities has a maximum of 1.79 when the magnetic induction is 172. The permeability rises to a maximum of 5900, and one would anticipate a considerably larger initial permeability than is generally supposed. The permeability was examined after varying periods of rest when the specimen was in a carefully demagnetized condition, and it was shown that its values gradually decrease as the duration of rest increases. The dissipation of energy due to magnetic hysteresis was examined when the magnetic induction had values as low as 0.68. It is well known that the Steinmetz index tends to increase as the lower forces are approached. The experiments indicate that the index tends again to diminish both in shielded and unshielded iron.—London *Electrician,* March 27, 1914.

Units, Measurements and Instruments

Convection Galvanometer.—W. H. ECCLES.—In an article on some instruments for high-frequency currents and voltages the author describes some convection galvanometers. These are instruments in which the energy dissipated in a resistance wire is measured by allowing the wire to warm the air surrounding it and then observing the convection currents set up. In the author's instrument the microbalance is applied to the measurement of minute convection currents in gases. The horizontal torsion fiber *AB* (Fig. 1) was of glass about 18 cm long. A tapering tubular glass lever *CD* was about 12 cm long. This was balanced on the tor-

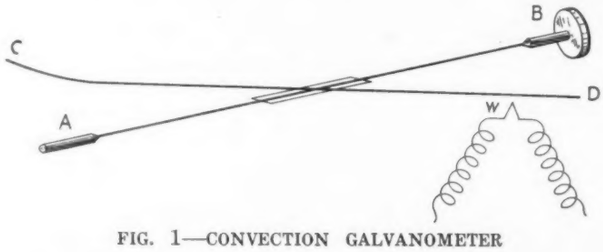


FIG. 1—CONVECTION GALVANOMETER

sion fiber and fixed to it by aid of a minute plate of mica and thin shellac varnish. Beneath the thin end of the lever was placed the wire carrying the current under measurement. It is essential to have the convector wire adjustable laterally so that the lever may be in the middle of the convection current. Perhaps the best form for the heater is an isosceles triangle of

about 15 deg. vertical angle. If the heater is a piece of platinized quartz fiber, this forms one side of the triangle and a very thin piece of copper wire the other side. It is not good to have the heater wire horizontal. When using the instrument the movement of the end of the lever must be observed by means of a horizontal microscope provided with an eyepiece scale. With such

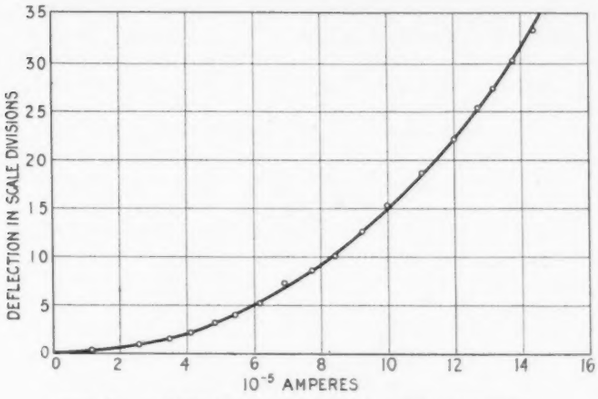


FIG. 2—CALIBRATION CURVE OF GALVANOMETER

an instrument the full deflection is attained in less than half a second, and on stopping the current the lever returns to its zero accurately in three or four seconds. The calibration curve of a particular instrument is shown in Fig. 2. The converter was a platinized quartz fiber of 4140 ohms resistance; its upper end was between 1 mm and 2 mm below the lever. Using a microscope magnifying only twenty diameters, the smallest readable deflection was produced by a current of about 10 microamp, which corresponds to an energy consumption of four ergs per second. This instrument was unable to perceive the energy of a single discharge of a condenser even when this was raised to 1000 ergs. The necessary convection current does not become established in the short time of the discharge. With a more recent instrument which the author has not yet thoroughly tested, a fraction of a microampere can be detected.—London *Electrician*, March 27, 1914.

Measuring Transformers.—H. GEWECKE.—A long article illustrated by diagrams in which the author discusses the operation of measuring transformers and especially the variation of the transformation ratio and the angle between primary and secondary currents or emfs. The discussion is based on the general transformer diagram, from which special vector diagrams are derived. Several zero methods are discussed by means of which the transformers can be tested carefully. Some practical hints are added.—*Elek. Kraftbet. u. Bahnen*, March 14, 1914.

Testing Iron.—J. F. VAN LONKHUZEN.—After a brief reference to several laboratory methods for magnetic iron tests, the author describes a differential method for commercial purposes. He emphasizes that especially with the new special silicon steels for electrical purposes continuous control by magnetic tests is very important.—*Mitteil. Siemens & Halske*, January, 1914.

Telegraphy, Telephony and Signals

Gott System of Submarine-Cable Telegraphy.—An illustrated article on the method of telegraphy through long submarine cables devised by John Gott, whose death recently occurred. The principle of the method is that the direction of the current is changed after each signal by means of a polarized relay, through which the cable is discharged. Fig. 3 shows a cable arranged for duplex working. The cable itself is shown at *a* and the artificial cable at *b* with its unconnected end earthed. Between the real and the artificial cable is inserted the receiving instrument *v*, as in the ordinary duplex system. The transmitting key *d*, however, is arranged so as to connect *e* either with *g*, as when at rest, or when depressed at *f* with *j*, as when sending a signal. Both these connections lead to the polarized relay *h*. On pressing the key the cable is put

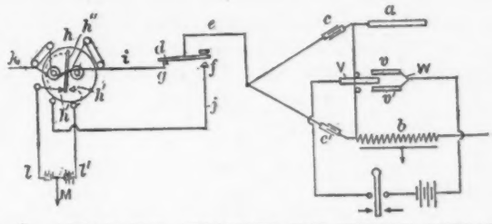


FIG. 3—APPARATUS ARRANGED FOR DUPLEX OPERATION

into connection with the movable tongue *h''*, and through it with one of the stops *h'*, each of which is connected with one pole of the split battery at *l* or *l'*, the center of the battery being earthed at *M*. Thus depressing the key charges the cable with a polarity depending upon which of the stops *h'* the movable tongue *h''* is touching. On permitting the key to return to its normal position contact is made at *g*, causing the cable to discharge through the polarized relay, and the direction of the current is always such that it causes the movable tongue to pass from one step to the other, reversing the polarity of the battery connection in readiness for the next signal. Thus successive im-

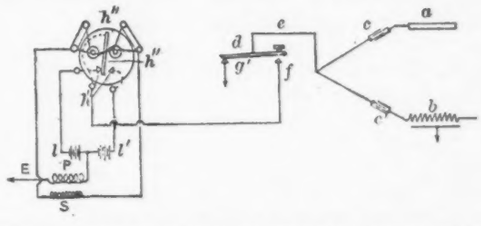
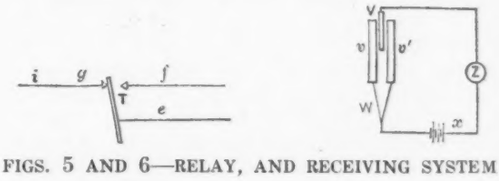


FIG. 4—MODIFICATION OF SENDING EQUIPMENT

pulses are always of different polarity, and the discharge from the cable is utilized to effect this reversal, at the same time restoring the cable to a natural condition, so that rapid signaling is possible. A modification of the sending method involves the use of a transformer in connection with the polarized relay, as shown in Fig. 4. The condenser and cable are earthed directly at *g'* after each signal and while the key is open. The split battery is earthed at *E* through the primary coil *P* of the transformer. The coils of the polarized relay are in connection with the secondary of the transformer *S*, and the contact point of the key *f* is connected through the movable tongue *h''* with the stops that in



FIGS. 5 AND 6—RELAY, AND RECEIVING SYSTEM

turn are connected with the split battery. The function of the transformer is to induce in the secondary coil, which is connected with the coils of the relay, a current that will send the tongue over against one of the stops and hold it there. Releasing the key will cause a current of opposite polarity to flow through the relay, sending the tongue over against the opposite stop, as

described above. An advantage claimed for this method is that on making contact with the key to charge the cable the battery contact in the relay is reinforced at the moment the key is depressed, thus insuring perfect transmission. To substitute for the hand key the tongue of the relay of a land line is very simple, as is shown in the diagram (Fig. 5), where *T* takes the place of the key *d*. Automatic transmission is also possible, using the Wheatstone transmitter. To understand the receiving system the diagram (Fig. 6) should be examined in connection with that of the sending station. At *v*, where the siphon recorder ordinarily is placed, a similar instrument provided with a contact-making tongue attached to the moving coil is used. This tongue or arm makes contact with either *v* or *v'*, depending upon the polarity of the current coming through the cable. These plates in the instrument are connected at *w* and are in circuit with the local battery *x* and a sounder or recorder at *z*, which, however, may be a relay or any desired instrument. While the contact piece at *v* will move from one side to the other, depending upon the polarity of the arriving current, the effect on the local circuit will be the same in either case, and the dot or dash is sounded or recorded just as in ordinary Morse working.—London *Elec. Review*, March 20, 1914.

Effect of Meteorological Phenomena of Wireless Telegraphy.—PAUL LUDEWIG.—An account of an extended investigation, the chief results of which are as follows: The intensity of signals received at a receiving station from the same transmitting station is practically constant during the day. During the night it varies enormously and is greater than during the day, sometimes four or eight times as great. During the day wireless messages can be transmitted over longer distances by the use of longer wave-lengths; no such relation holds good during the night. At sunrise and sunset the amplitudes of the signals vary very considerably. All these phenomena manifest themselves the more clearly the greater the distance between the two stations. An eclipse of the sun acts in a way similar to sunset. The intensity of the waves received during the day is little affected by the season of the year. The influence of the moon and of the aurora borealis is not yet sufficiently explained. The latter is said to dampen sometimes the effect and sometimes to increase it; it certainly has a considerable effect. The damping of the transmitting station varies during the day by 20 to 30 per cent.—*Elek. u. Masch.* (Vienna), March 8, 1914.

Miscellaneous

Protective Devices.—W. WOLF.—An article, illustrated by diagrams, on recent progress in protective devices for protecting switchboard and measuring instruments against high voltages.—*Elek. Kraftbet. u. Bahnen*, Jan. 24, 1914, and Feb. 4, 1914.

German Electrical Industries.—A continuation of the concise reviews of the status of the different electrical industries of Germany in 1913. C. Buschkiel deals with the uses of electricity in agriculture, A. Kussler with electric hoisting and transportation installations, W. Philippi with electricity in mining and metallurgy, Stauch with the use of electricity on board ship.—*Elek. Zeit.*, March 26, 1914.

Pichelmayer.—A review by Ossana of the life and work of the late Karl Pichelmayer, professor of the Institute of Technology of Vienna, with his portrait.—*Elek. u. Masch.* (Vienna), March 8, 1914.

Waltenhofen.—An account with portrait, of the life and work of the late A. von Waltenhofen, formerly professor of physics and electrical engineering at Innsbruck.—*Elek. u. Masch.* (Vienna), March 15, 1914.

Book Reviews

ELEMENTARY THEORY OF ALTERNATE-CURRENT WORKING. By Capt. G. L. Hall. London, England: The Electrician Printing & Publishing Company, Ltd. 196 pages, 130 illus. Price, $1.50.

An elementary textbook on alternating currents and alternating-current machinery, intended for the use of students acquainted with the principles of direct-current machinery and circuits. The mathematics employed are simple and reliance is placed upon mechanical analyses to explain many of the phenomena of alternating-current circuits. Vector diagrams are also used to advantage. The eleven chapters of the book relate to the following subjects: Alternating currents; inductance; capacity; resonance; power measurement; polyphase systems; transformers; generators; synchronous motors; induction motors; commutator motors. In spite of the elementary character of the treatment the book is characterized by a directness and precision of statement and definition which more advanced textbooks might well imitate. The chapters on alternating-current motors are particularly helpful and well prepared. The book will commend itself to a large circle of electrical students.

PUBLIC UTILITIES: Their Cost New and Depreciation. By Hammond V. Hayes. New York: D. Van Nostrand Company. 262 pages. Price, $2.

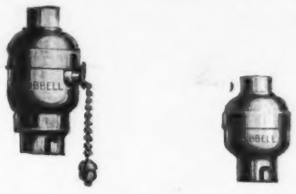
Writing from the standpoint of the engineer, the author still feels that the engineer must have sufficient knowledge of the legal questions at issue to enable him to obtain the figures needed by courts and commissions that determine fair present value. He argues that the appraiser should not ascertain fair present value, as that is a function of court or commission, but should ascertain accurately the necessary figures of value and loss of value; that original cost can be obtained without inordinate difficulty and is important to those who determine fair present value, and that "depreciation is affected only indirectly by inefficiency and that, as a necessary consequence, depreciation is dependent wholly upon the relation of the age to the life of the perishable property." The author, however, qualifies his limitation upon the ascertainment of fair present value, which he considers as the function, not of the engineer, but of the court or commission. In his extended discussion of fair present value he says that the legislature, commission or undertaking itself should consider this value as the amount of money expended in good faith and with reasonable judgment in construction of the property in use and serviceable for the public at the time of investigation, provided that value has been maintained by proper reserves for renewals. This value then would be used as a basis for rate-making to yield a fair return. If "proper reserves for renewals" had not been maintained, would "fair present value" be reduced by the amount that, in the judgment of the final authority, should have been set aside for that purpose but was not? A plant may be operating at full efficiency, yet be without reserves and therefore obtain a valuation less than enough to yield a fair return upon the cost determined as to other respects in accordance with this definition. The difficulty which has been experienced so often in the effort to determine original cost arises from incompleteness of records. There are so many elements of depreciation that it is impossible, within the scope of a brief review, to discuss them adequately. Much of the discussion of the author is admirable and, although every treatment of the great topics involved is open to question from some standpoint, the work is an important contribution to public-utility literature.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Pull and Keyless Sockets

Small pull and keyless sockets with bases designed particularly for use in and about automobiles and motor boats have been put on the market by Harvey Hubbell, Inc., Bridgeport, Conn. The mechanism of the pull socket is similar to that of other pull sockets of this

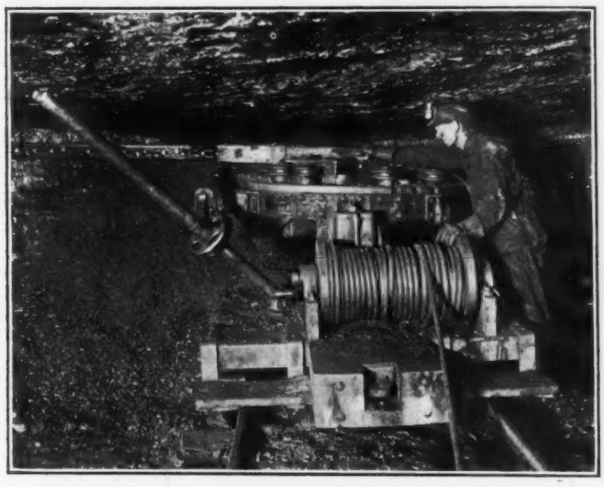


FIGS. 1 AND 2—PULL AND KEYLESS SOCKETS

manufacturer. The device is equipped with double-plunger contacts, which, when depressed by inserting the lamp, cause sufficient tension against the base of the lamp to prevent its jarring loose. Double phosphor-bronze springs working in opposite directions and having sufficient rigidity to hold the lamp securely in the offset slots are used with the keyless sockets. The shell and cap of the pull sockets are fastened together by screws, and those of the keyless socket by a sliding catch.

Motor-Driven Top-Cutting Mining Machine

In the accompanying illustration is shown a recently developed motor-driven top-cutting machine for use in coal mines. It consists of a breast machine mounted on a turntable truck so that it can be employed in narrow



BREAST MINING MACHINE FINISHING A CUT

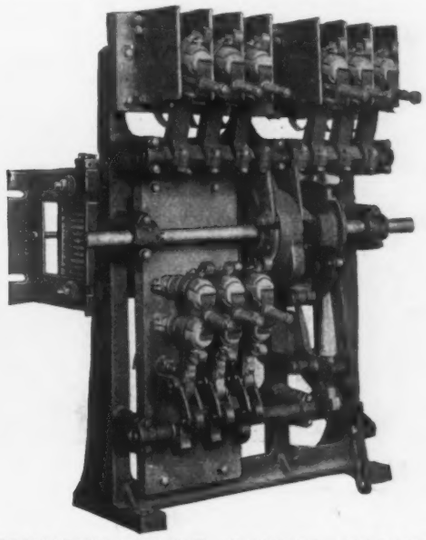
passages. No manual labor is required in handling this machine as the cutting chain, turntable and feeder mechanism are operated by a motor. No slack has to be shoveled when this apparatus is employed, and the roof is not weakened considerably, as only narrow slots are cut in the wall. Machines of this type can be inverted to cut away a dirt band at the top of a seam. A gathering locomotive is required to transfer this cutter from one place to another, but similar apparatus is manufactured which is self-propelling. The type shown herewith, employing a gathering locomotive to make transfers, will cut as many as forty 12-ft. walls in ten hours, while self-propelling machines will cut twenty-four to thirty places in the same time. This machine is built by the Jeffrey Manufacturing Company, Columbus, Ohio.

Alternating-Current Elevator Controller

A mechanical-type elevator controller for alternating-current equipment is being placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. This controller is designed for polyphase slip-ring induction motors. No electromagnets or sliding contacts are employed. The device can be worked from the car by rope or lever, the shaft being provided with an extension at each end so that the controller can be adapted for either right-hand or left-hand operation.

The primary circuit is controlled by two sets of switches, each set consisting of three single-pole switches equipped with arcing shields. Each set of primary switches is operated by a special internal cam, which is designed to give an absolute "knock-out" to the switches when opening and an absolute "lock-out" for the second set of switches when the first set is thrown in.

The secondary resistance is cut out by three triple-



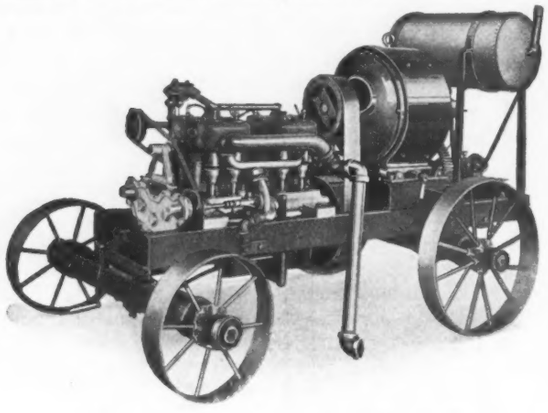
ALTERNATING-CURRENT ELEVATOR CONTROLLER

pole cam-operated switches. Immediately after the primary switches are thrown in a catch is released, thereby causing a weight to drop; the motion of this weight is retarded by a suction dash-pot. The weight in turn drives a shaft on which the necessary cams

are mounted for throwing in the secondary switches. The secondary resistance is cut out simultaneously in all three phases of the rotor circuit, thus insuring a balanced condition at all times. The secondary resistance is reinserted upon the opening of the primary switches. A latching arrangement is provided for preventing accidental operation of the controller when the operating mechanism is not thrown to the central position.

Generator for Lighting Amusement Devices

A portable generating equipment for the illumination of amusement devices is shown herewith. The outfit consists of a 115-volt compound-wound, direct-current



LIGHTING OUTFIT FOR AMUSEMENT DEVICES

generator which is connected by a short belt with an idler-pulley attachment to an automobile engine. Both engine and generator are mounted on a steel-frame truck. The switchboard is placed directly in front of the generator and is equipped with switch, fuses and a Ward-Leonard wall-type rheostat. Generators of 2-kw, 3-kw, 5-kw, 7.5-kw and 10-kw rating are used. The outfit has been designed and is being placed on the market by Mr. C. W. Parker, Leavenworth, Kan. The generators are manufactured by the Robbins & Myers Company, Springfield, Ohio.

Electric Welding in the Construction of Drills

Electric arc welding with metallic electrodes is being applied by the Dulles-Baldwin Electric Drill Company, New York, in the manufacture of an electric piston rock

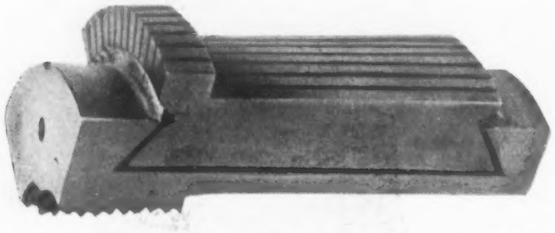


FIG. 1—OUTSIDE VIEW OF COMMUTATOR SUBJECTED TO ELECTRIC WELDING

drill similar to that described in the *Electrical World* of Feb. 9, 1911. The service requirements of motors for use with this kind of drill are very severe, and on account of excessive vibration the commutator is liable to be affected. By means of electric welding commutator troubles are said to be almost entirely eliminated. The commutator segments, which are insulated from each other, are assembled about a sleeve and are insulated from the sleeve itself by a layer of mica which extends along the entire bottom of the segments as shown in the illustrations. When assembled upon this sleeve a clamping ring is forced over the outside and the sleeve is pressed firmly against the segments from the end. A bevel ring is then clamped over the other

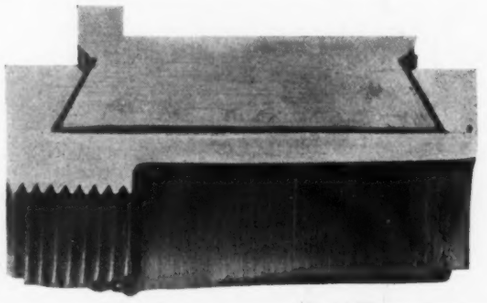


FIG. 2—INSIDE VIEW OF COMMUTATOR SUBJECTED TO ELECTRIC WELDING

end and welded to the sleeve. The welding material which is deposited by the metallic arc method is built up on the end of the sleeve. On contracting, the metal grips the segments between the end rings, which form one integral part with the sleeve. The contractive force produced by this method is so great that the segments are forced down to the bottom of the bevels and rest upon the outer wall of the sleeve throughout their entire length. Instead of the cast-iron frame formerly employed, use is made of a pressed-steel ring with pressed-steel ends and feet, the different parts of which are welded together. Similar changes have been made in the drill itself by using pressed-steel tubing and welding the parts together. The welding for this drill is being done by the Electric Welding Company, New York.

Reflector-Type Glowing Electric Stove

An electric stove of the glowing-coil type equipped with a reflector has been put on the market by the Hotpoint Electric Heating Company, Ontario, Cal. This device, which weighs only 2 lb., has a diameter at the top of 7.25 in. and at the base of 6 in., and it is 4 in.

GLOWING-COIL ELECTRIC STOVE

high. The frame is made of pressed steel and the heat reflector of burnished brass. The stove is patterned after a chafing dish and is finished with polished nickel. The heating element can be easily removed; it consumes 600 watts. The stove can be operated from any lamp socket.

Electric Vulcanizer for Automobile Tires

The greatest damage to automobile tires is said to be caused by the neglect of cuts, sandpockets, stone and glass in the casings. Unless the cuts and sandpockets are sealed at once, dirt and water work into the fabric,

APPARATUS FOR VULCANIZING AUTOMOBILE TIRES

thereby causing it to rot, with the result that a blowout eventually occurs.

The vulcanizing apparatus illustrated herewith is designed to seal cuts and pockets in rubber tires with a weld of live Para rubber. A uniform temperature of 265 deg Fahr. is maintained by means of a thermostat which is in series with the heating element. The heating unit completely fills the interior of the vulcanizer, thus conducting the heat evenly to every portion of the repair so that it cannot be "over-cured" in one place and "under-cured" in another. Current may be obtained from any lighting circuit. The vulcanizer is attached to the tire by means of the clamp shown. This vulcanizer is manufactured by the C. A. Shaler Company, Waupun, Wis.

Instrument for Locating Faults in Power Cables

For many years telephone linemen have been tracing and locating cable troubles by means of a coil and telephone receiver designed to respond to magnetic fields created about cables by pulsating currents. Only recently, however, in an instrument marketed by W. N. Matthews & Brother, St. Louis, has this principle been successfully worked out for power cables. This device, known as a "telefault," consists of a generator of high-frequency current, a specially designed exploring coil, and an attached telephone receiver.

The sending instrument or generator consists of four dry cells, a non-inductive resistance, an unbalanced coil, an interruptor and a condenser. One pole of the set of four dry cells is brought out to a terminal post which may be connected directly to the cable in trouble. From the other battery terminal a lead is conducted through the unbalanced coil and the non-inductive resistance, and this lead is connected to the lead sheath of the cable. A tap taken off at a predetermined point in the unbalanced coil is connected in multiple across the unbalanced coil, the battery, and the interruptor or buzzer which creates the pulsating current in the cable under test.

The particular improvement in the apparatus lies in the design of the exploring coil, to which is attached a telephone receiver. These two devices form the portable part of the set carried by the lineman tracing the trouble. The exploring coil consists of two laminated cores built up of non-aging steel plates, each core being insulated from the other by means of a fiber block performing the dual function of separating the magnetic cores and acting as a headboard for connections. Three separate and distinct windings are placed on each core. The first or bottom coils on the magnetic core are connected in series with the open ends brought out to terminals on the fiber block. At a predetermined point the second coil is connected to the winding of the bottom coil, is wound in parallel with it, and has its free ends brought out to a short-circuiting device on the fiber headboard. The third coil, a differential winding, has its length so proportioned that its resistance is intermediate between the first and the second coil. Its free ends are connected on the headboard so that its magnetic field will oppose the fields of the first and second coils.

As will be noted from the accompanying illustration, the windings are so arranged in the exploring coil as to form an arc of a circle about the conductor under test. Thus in locating a case of trouble after the generator has been connected to the defective lead repairmen have but to open manholes and apply the exploring coil to the cable in question. The presence of noise in the receiver will then inform the inspector whether he is beyond the case of trouble or not. If his exploring coil picks up the pulsating current, the repairman at once knows that the fault is not between him and the station at which the sending instrument is in operation. Pressing the button which controls the short-circuiting device on the exploring coil changes the tone of the instrument and eliminates the possibility of the repairman being led astray because of the presence of "sneak currents."

The use of this instrument eliminates the older and

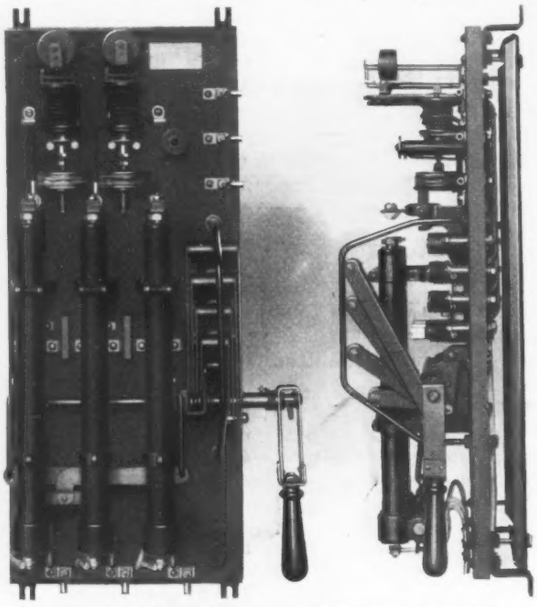
APPARATUS FOR FINDING FAULTS IN POWER CABLES

more expensive method of cutting the cable at frequent intervals in order to locate the fault and is also said to be quicker and more economical than the Wheatstone-Bridge method. The device, it is said, will locate within a few inches any cross or ground in the cable.

Alternating-Current Motor Starters

A resistance-type starter for squirrel-cage and slip-ring motors is being manufactured by the Allen-Bradley Company, 495 Clinton Street, Milwaukee, Wis. The resistance is of the graphite compression type and consists of graphite disks piled in columns having imperfect contact with each other. The resistance varies with the pressure applied. The columns of disks are inclosed in air-tight insulated steel tubes, as shown in the accompanying illustration, one column being supplied for each phase.

A no-voltage release is provided which consists of weighted levers held in an upright position by magnets and so connected that each phase has an individual magnet in series with it. If the circuit is interrupted, the magnets are de-energized and the weighted levers swing down and release a latch which returns the starter to the "off" position. This is also accomplished if trouble is encountered in only one phase; in this case



ALTERNATING-CURRENT RESISTANCE STARTER

only the coil belonging to that phase is de-energized and the weighted lever is released as before.

Two adjustable relays can be provided to take the place of fuses. When an overload occurs, one or both of the relays operate and stop the motor. The relays are provided with time limits. These type H starters, as they are known, are inclosed in steel cabinets.

Electric Washer with Non-Geared Drum

An electric washing machine recently placed on the market by the Capital Electric Company, Insurance Exchange Building, Chicago, Ill., embodies a principle new to mechanical washers. A 0.25-hp motor swung beneath and at the rear of the tub is directly connected to a propeller in the bottom of the tub, so that the revolving propeller blades will force a stream of hot, soapy water upward with considerable velocity. Clothes placed in the perforated cylinder shown in Fig. 2, being in the path of this stream, are cleansed by the passage of water through them. The cylinder itself has no connection with the motor but is revolved by the force of the stream of water, which is applied somewhat off center. When the washing has been finished the cylinder may be lifted to a higher support, placing the clothes where they will be accessible for wringing. The wringer which is attached to the machine is driven from the motor by the utilization of a rod and bevel gears.

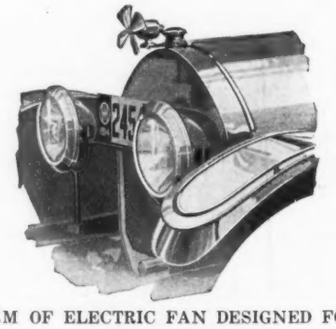
It is said that the washing for an ordinary family can be accomplished with this machine in about ten or

FIGS. 1 AND 2—ELECTRIC WASHING MACHINES

twelve minutes after soap and water have been prepared, the cost for electrical energy being approximately 2 cents. The machine complete stands 39 in. above the floor and can be set in a space measuring 24 in. in width by 24 in. in depth.

Automobile Novelty Fan

A small novelty fan, symbolic of the electric industry, which can be mounted on the radiator of an automobile as shown in the accompanying illustration, has been designed by the Robbins & Myers Company, Springfield, Ohio, as an advertising aid for electrical dealers and contractors. The air currents caused by the movement



NOVEL FORM OF ELECTRIC FAN DESIGNED FOR USE ON AUTOMOBILES

of the car operate the fan. The base of the fan is tapped for a stud bolt. The usual method of mounting the device is to tap the cap which covers the opening to the radiator and attach the fan directly to this cap. Another method is to mount the fan on an iron strap, which is clamped around the cap in the method illustrated.

Nitrogen-Filled Street Lamp

A tungsten lamp of the so-called "arc" type has been designed by the Philadelphia Electrical & Manufacturing Company, 1228 North Thirty-first Street, Philadelphia, Pa., for street-lighting purposes. The lamp is not

TUNGSTEN STREET LAMP WITH LARGE GLOBE

of the arc type, properly so called, use being made of high-efficiency nitrogen-filled incandescent lamps. The unit is equipped with either series or multiple sockets. Proper glassware for obtaining the best lighting effect is employed in the making of this fixture. This tungsten "arc" lamp is shown in the accompanying illustration.

Boltless Automatic Strain Clamp

A boltless automatic cable strain clamp for high-tension transmission lines is shown in the accompanying illustration. It consists of three pieces and is designed for use with cables ranging from the No. 2 size up to the No. 0000 size, either stranded or solid. The clamp takes the strain as soon as placed in position, and the greater the strain the greater the clamping power. The manufacturers claim that the clamp will not slip under any strain nor will it let loose until the cable itself breaks. Owing to the fact that the clamping area is lengthwise of the cable and the dead-end eyelet is practically in line with the axis of the cable, kinking is avoided.

BOLTLESS STRAIN CLAMP

This clamp, which is manufactured by the Automatic Cable Clamp Company, Donara, Pa., is designed for dead-ending at strain towers, for jumpers, for anchorage at walls of power houses, for sharp turns in transmission lines, for various kinds of central-station work and for catenary construction of electric railways. The clamp is sherardized and is rust-proof.

Recording Synchroscope

A synchroscope which makes a permanent record of each operation of switch closing when paralleling units is manufactured by Messrs. Schweitzer & Conrad, 1770 Wilson Avenue, Chicago, Ill. The instrument consists of a paper-holding and shifting device, an insulated ring in the synchroscope dial and a spark coil with a vibrator. With the energizing of the spark coil at the time the control switch coil is closed, a succession of

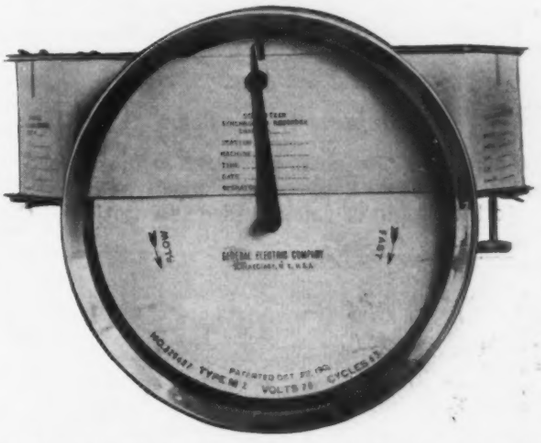
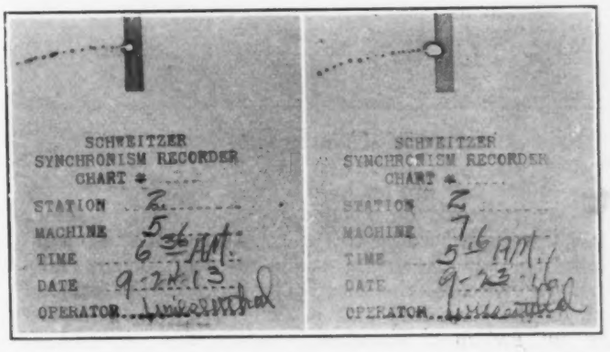


FIG. 1—SYNCHROSCOPE WITH RECORDING ATTACHMENT

sparks jump from the insulated ring to the electrode on the pointer, puncturing the paper and thereby forming the record.

A continuous ribbon of paper is fed from a metal spool on the left along guides and across the upper half of the synchroscope dial to the right, as shown in Fig. 1. A brass ring is set in flush with the surface of the dial plate, which is made of insulating material. The length of the radius of this ring is somewhat less than that of the instrument pointer. An insulated stud extends through to the back of the indicator case. A platinum point is attached to the under side of the pointer and directly in front of the ring.

One of the leads from the spark-coil secondary is connected to the insulated stud and the other to a stud screwed into the instrument case. The primary leads are connected through an auxiliary contact to a direct-



FIGS. 2 AND 3—CHARTS ILLUSTRATING GOOD SYNCHRONIZING

current circuit. The purpose of the auxiliary contact is to close the circuit to the spark coil primary simultaneously with the closing of the control switch, and to keep it closed until opened by the operator.

For a perfect operation the record will be a very short row of quite large punctures. All of these are on one side of the synchronous position when the machine runs

faster than the system frequency, and all on the other side if slower. If the operator closes the control switch too early for perfect synchronizing, the record shows a succession of almost uniformly spaced punctures between the time the control switch is closed and the instant the oil switch closes and then a much wider spacing as the pointer is jerked quickly to the synchronous position (see Figs. 2 and 3). If the operator closes his control switch too late, the record will extend beyond the synchronous position. A change in beat or in the rate of rotation of the synchroscope is shown by both the difference in spacing and the size of the puncture.

Outdoor Substations

The advent of the small consumer in the vicinity of transmission lines has brought much attention and effort to the design of small outdoor substations. Out-

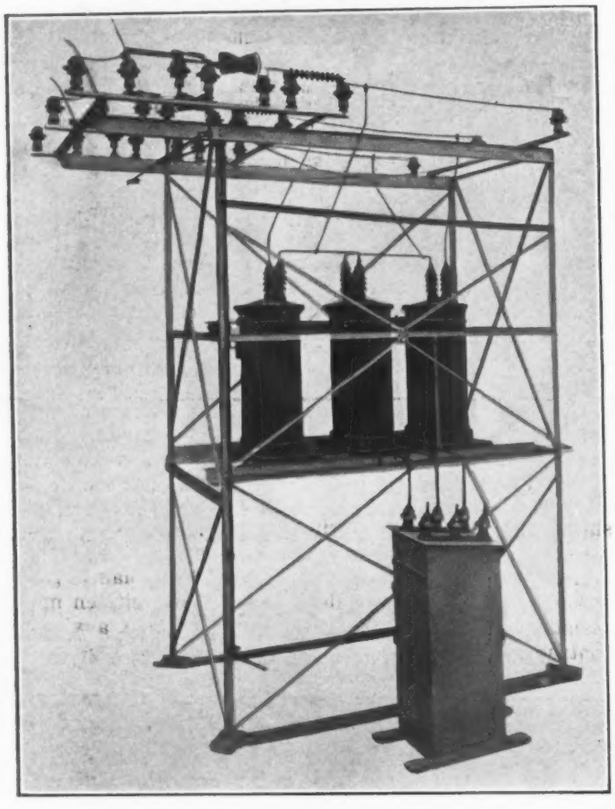


FIG. 1—OUTDOOR SUBSTATION ON STEEL TOWER

door substations are made in a great variety of designs and are mounted on wooden poles, wooden towers or steel towers, according to the requirements of each installation. On the primary side the equipment usually includes switches, choke coils, fuses and transformers, and on the secondary side it varies from one comprising oil switches, watt-hour meters and instrument transformers to one utilizing a lever switch with fuses.

The primary switches are of the air-break type and are made in three designs, one in which the switch opens upward and is operated by hand or by a motor which is usually at the bottom of the pole below the switch blades, another where a lever switch opens downward and is operated by the usual switch hook, and a third type with contacts moving in the direction of the line, the operation being by hand or by a motor. The high-voltage switches are equipped with horn deflectors which assist in rupturing the arc when the branch line is opened under load. The primary fuses are mounted vertically and make contact with clips in closing like the ordinary knife switch. These fuses are a modification of the expulsion type and are designed either to take the place of the primary switch or to be used for horizontal mounting without the switch feature. They

FIG. 2—STEEL SWITCH HOUSE

are made up in three-pole units and are operated from the ground by a rod or a rope.

The transformers are single-phase and are designed especially for outdoor service. The choke coils are either of the hourglass type or of a new design known as the suspension type. For the secondary circuit the oil switches, watt-hour meters, etc., are of standard construction for indoor service and may be mounted on a panel in a wooden or steel house. They are furnished completely wired and ready for immediate service.

Two styles of houses are made. In the one a slate or steel panel carries an oil switch provided with a series trip coil for protection from overloads and also a watt-hour meter. The instrument transformers are mounted on the side walls and the buses are attached to the roof. In the other style, which is used for 440-volt distribution, a comparatively small house suitable for mounting on a pole of the transmission line is used. This house contains a small panel with a lever switch and inclosed fuses for overload protection.

In Fig. 1 is shown an installation of high-tension

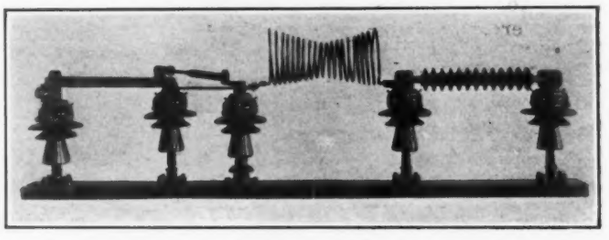


FIG. 3—35,000-VOLT SWITCH, CHOKE COIL AND FUSE

switching and protective apparatus and three single-phase transformers on a steel tower for supplying energy to rural consumers from a 35,000-volt transmission line. Fig. 2 shows the type of steel switch house used. These substation have been developed by the General Electric Company.

Jobber, Dealer and Contractor

Chicago Arrangements for Atlantic City Jobbers' Convention

While the detailed program for the convention of the Electrical Supply Jobbers' Association to be held at the Hotel Chalfonte, Atlantic City, on May 12, 13 and 14 had not been made out by the secretary at the time this paragraph was written, there is no doubt that an attractive series of events will be arranged. It is expected that a party will go from Chicago, and arrangements have been made for a special car on the train over the Pennsylvania Railroad leaving the Union Station in Chicago at 5:30 p. m. on Sunday, May 10. Mr. Franklin Overbagh, of 411 South Clinton Street, Chicago, is the general secretary of the association.

Co-operating with the Contractors at Boston

A vigorous electric-toaster campaign was started a few days ago by the Edison Electric Illuminating Company of Boston in co-operation with about fifty electrical contractors in its territory, and these devices are being sold at the rate of about 1000 a fortnight at a special price of $2.95 each. The toasters are of the Landers, Frary & Clark "Therwax" type, being rated at 3.1 amp at 110 volts, and ordinarily retail for $4. In planning the campaign the company got in touch with all the contractors in its 700 sq. miles of territory who have responded to the house-wiring opportunities lately afforded by the company and secured contributions of from $1 to $10 toward the cost of newspaper advertising in four prominent Boston dailies for a two weeks' period. The company buys all the toasters and places them with the contractors at a price which yields the latter a small profit on each toaster, taking back any unsold outfits. In the advertisements run on the co-operative basis the names and addresses of the local contractors carrying these devices are printed, and the company furnishes free of charge special signs and cuts for use in suburban papers by contractors carrying local "ads." The success of the plan will lead to further special appliance campaigns in the near future.

Cost of Miniature Christmas-Tree Bulbs

Details regarding the cost of making fancy electric lamp bulbs in Germany were revealed in a decision of the Board of United States General Appraisers handed down recently. The case decided was that of A. Wolff & Company, of New York, who imported the goods for Christmas tree decorative purposes. The bulbs were colored to represent twenty-four varieties of fruits. The collector classified the goods as articles in chief value of blown glass, under paragraph 98, tariff act of 1909, while the importers claimed 45 per cent, under the provisions for manufactures in chief value of metal. The contention of the importers was that metal predominated in the make-up of the bulbs and should rule in the classification. One of the witnesses testifying on this point gave the relative values as follows: Metal base, 0.6 cent; leading-in wire, 0.02 cent; nickel wire, 0.05 cent; platinum, 0.5 cent; four joints of platinum and copper and nickel alloy, 0.12 cent; joints of the filaments, which are nickel, 0.3 cent; filament, 0.35 cent; solder, 0.2 cent; while the breakage cost of putting the materials together, or the waste, amounted to about 10 per cent. It was stated that the globes are manufactured in this country at the price of $1.25 per 100, while in Europe the cost is 95 1-5 cents per 100. The cost of painting the globes amounted to 0.25 cent each. The judge in his decision sustained the claim for lower duty and overruled the collector's adjustment.

Cleveland Company Co-operates with Contractors in Store Wiring

The Cleveland (Ohio) Electric Illuminating Company, long a pioneer in the field of co-operation with wiring contractors, has recently put into effect a contract carrying a definite unit-outlet schedule for commercial wiring. Contractors do the soliciting and are paid 10 per cent of the cost of the wiring by the illuminating company as a bonus for the solicitation work, with the stipulation that in no case shall the bonus be less than $5 or more than $10. The accompanying table, taken from the contract, shows the cost of wiring any number of outlets from five to twenty.

CLEVELAND COMMERCIAL WIRING SCHEDULE

Number of Outlets	Concealed Work or Wood Molding	Metal Construction
5	$22.10	$30.85
6	25.35	35.85
7	28.60	40.85
8	31.85	45.85
9	35.10	50.85
10	38.35	55.85
11	41.00	60.25
12	43.65	64.65
13	46.30	69.05
14	48.95	73.45
15	53.00	77.85
16	54.25	82.25
17	56.90	86.65
18	59.55	91.05
19	62.20	95.45
20	64.85	99.85

The practice of paying contractors for soliciting wiring has been a marked success in Cleveland as shown by the fact that during the past year 2500 houses were wired. Where the central station has a large foreign population to serve the success of the plan is particularly assured, for while a foreign-born citizen may resist all efforts of a good American salesman, a wiring contractor who can speak the prospective customer's own tongue will be able to gain his confidence and can secure often business otherwise impossible. It is estimated that the sixty-five contractors in Cleveland will be able to secure 100 commercial wiring jobs a month as a result of the new schedule.

Electrical Contracting in Old New England

"I have not done more than $125 worth of electrical work in the last three years, so I am planning to sell out this spring and get entirely out of the electrical business," is the text of a letter written by a discouraged contractor living in a New England town of 8000 population, the history of which antedates the Revolutionary War.

"This action on my part has been forced as the result of the attitude taken by the lighting company, the labor unions and unscrupulous contractors. I refused to do work that would not pass the Underwriters' requirements, while at the prevailing price for work there is no profit. About five years ago the local manager of the electric company went into business as an electrical dealer and succeeded in keeping afloat for about three years. At the end of that time he failed and paid about 20 cents on the dollar. This put the elec-

trical business 'on the hog,' and it has been so ever since.

"The lighting company tried for a time making wiring installations on the instalment plan, getting two sidewalk contractors to do the work for them. However, under this arrangement only three jobs were secured. One of the sidewalk contractors is now in jail for sixty days on the charge of stealing from the ruins of a recent fire.

"Concerning provisions for electrical inspection here, the town has a paid fire department, the chief of the department acting as building inspector and the assistant chief as wiring inspector. Neither of them has had any previous experience in the work they are called upon to do so far as can be learned."

Meeting of Electrical Contractors' Association of Wisconsin

At a special meeting of the Electrical Contractors' Association of Wisconsin held at Milwaukee April 6 and 7 Mr. Thomas M. Ferguson, a member of the Plumbers' Examining Board of Wisconsin, spoke on "What Organization Has Accomplished for Us"; Mr. W. R. Johnson, Wausau, outlined a cost-accounting system; Mr. Taylor Frye explained the Wisconsin apprenticeship law, and Mr. H. G. D. Nutting, Milwaukee, gave a talk on the mutual interests of the central-station man and the electrical contractor. Routine business of the association was also taken up, but owing to the lack of sufficient time, discussion of the employers' liability law and the lien law was postponed for a future meeting.

In his talk Mr. Thomas M. Ferguson outlined the steps which had been necessary to secure a plumbers' license law in Wisconsin. Organization, he said, was in a large measure responsible for the success attending their efforts.

In his talk on accounting, Mr. W. R. Johnson, president of the Electrical Contractors' Association of Wisconsin, outlined the method which his firm was employing in Wausau to stop the small "leaks" which develop in the contractors' business. Mr. Johnson said that the first attempt at accounting made by his company showed that the amount of money saved by an accounting system more than paid for the extra expense involved in keeping a correct set of records.

The apprenticeship law of Wisconsin as outlined by Mr. Taylor Frye requires that minor apprentices who enter into contracts with employers must be allowed five hours each week for schooling. Continuation schools in each principal city of the State have been provided for the accommodation of apprentices and others. Fifty-five hours is given as the total time that any master can require a minor apprentice to work. In addition to these provisions, the law requires that the master agree to give some time to teaching the apprentice something of the business in which he is working.

On the authority of President P. H. Korst and Secretary George Allison of the Wisconsin Electrical Association, Mr. H. G. D. Nutting gave a candid talk on co-operation of central stations and electrical contractors, showing wherein each party is dependent upon the other. The central-station men realize that the hustling contractor is an asset and are always anxious to help this type of man, but if the contractor is not progressive and does not live up to his business agreements, the central station must refuse to deal with him in order to protect itself.

Speaking on the question of "Who is a legitimate contractor?" Mr. Nutting suggested that perhaps membership in the contractors' associations was as good an indication as could be had. Sometimes, however, it is the so-called "curbstone" contractor who brings most business to the central station, and as a matter of self-preservation the electric-service interests must co-operate with those who are able to secure the majority of the wiring contracts.

As a part of the routine business, a resolution was passed approving the bill, H. R. 14,288, now before the second session of the Sixty-third Congress, providing that separate bids for government electrical work, steamfitting and plumbing shall be submitted when the amount of the contract exceeds $1,000.

Mr. Herman Andrae, of Milwaukee, was elected state director of the National Electrical Contractors' Association to replace Mr. George F. Rohn, who has resigned that he may have more time for other business interests. Mr. Albert Petermann, Milwaukee, is secretary of the Electrical Contractors' Association of Wisconsin.

Practical Results of Window Displays

Window displays have been an important factor in the success of the Electric Shop, as the accompanying analysis of sales in relation to representative weekly exhibits shows. In one week when various sizes of tungsten lamps were displayed, with appropriate advertising, the sales of these lamps increased $72 over those of the preceding week. A count of the number of persons visiting the shop totaled 2299 in one week,

WINDOW DISPLAYS AND SALES

Dates of Display	Character	Sales	Previous Yearly Sales	New Yearly Rate
Sept. 1-8	Portable lamps, ornamental, business	19	186	988
Sept. 8-15	Fireless cooker	1 "prospect"	0	....
Sept. 15-22	Luminous radiator	19	22	988
Sept. 29-Oct. 6	Toasters	20	283	1040
Oct. 6-20	Hylo lamps	142	253	7384
Nov. 3- 8	Portable lamps	12	186	624
Nov. 10-17	Radiators	3	24	156

and another count showed that 25,100 persons paused in front of the Electric Shop window during the week's display of a Hylo miniature theater. On "Hotpoint Day," May 10, the company sold 235 "tostovos." Other activities included moving-picture shows at schools, appliance demonstrations, mailing circular letters to telephone subscribers, lectures before church and fraternal organizations, an electric tea-party in the suburbs, and newspaper advertising.

An interesting analysis by the sales department compares the holiday business in 1912 with that of 1913, the company having had no store in the former year and exhibiting appliances only in a limited way in its old offices, which were up one flight in an office building. After the establishment of the Electric Shop 739 appliances were sold in the holiday season, against 170 during the Christmas week of 112. Some of the comparisons are: Flatirons, 117 and 57; percolators, 50 and 15; heating pads, 39 and 18; toasters, 119 and 51; portable lamps, 180 and 1; vibrators, 6 and 1; egg-boilers, 4 and 1; curling irons, 14 and 2; water boilers, 45 and 7; small stoves, 26 and 4; grills, 61 and 3; chafing dishes, 23 and 7. A special line of lamps was put on sale Dec. 19 and resulted in the sale of 65.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Lecture by Samuel Insull in New York.—On the evening of April 20 Samuel Insull, president of the Commonwealth Edison Company of Chicago, will lecture before the finance forum of the Young Men's Christian Association, 318 West Fifty-seventh Street, New York City, on the subject "Concentration of Power Supply."

American Searchlamps Shipped Abroad.—Among the larger searchlamps recently sold by the Carlisle & Finch Company, of Cincinnati, Ohio, there were fifty ranging in size from 7 in. to 24 in. in diameter. A number of these were shipped abroad to England, Italy, Central America, British Honduras and the Philippines. These searchlamps are used largely on yachts, launches and river steamers.

Electrical Equipment for Bakery.—The Schulze Baking Company, of Chicago, is a large concern with several bakeries throughout the city. One of these, at South Wabash Avenue and East Fifty-fifth Street, has been recently equipped and will be electrically operated. The Commonwealth Edison Company has secured a contract for supplying electricity to 600 hp in motors and 2500 incandescent lamps in this large baking establishment.

Change in Control of Hart & Hegeman Manufacturing Company.—Since the death of Alfred H. Pease, president of the Hart & Hegeman Manufacturing Company, Hartford, Conn., in November last, the majority of stock has been owned by his widow, who last week sold all her holdings to local interests in Hartford. For the present at least no change will be made in the officers, and Shiras Morris will continue as president of the company.

Fair Demand for Power Plant Equipment Observed.—The Alberger Pump & Condenser Company, of 90 West Street, New York, is finding business conditions in its line satisfactory, with the greatest activity in the South and West. At present numerous orders for small apparatus are being received. The company is supplying condensing equipment for the new station under construction at the present time by the Montreal Light, Heat & Power Company.

T. C. White Company's Business to Go on Without Interruption.—Following the recent death of Thomas C. White, proprietor of the T. C. White Company, of St. Louis, announcement is made that the business will be conducted under the same name by the sons of the decedent, O. K. White and W. H. White. The T. C. White Company has its office at 1124 Pine Street, St. Louis. It manufactures railway and lighting specialities, including line insulators, line-suspension material and appliances of that character.

Sale of Corliss Engines Not Active.—Through Olney & Warrin, of 66-68 Centre Street, New York, recently appointed agents of the Murray Iron Works Company in the metropolitan district, it is learned that the sale of that company's line of small and medium-sized Corliss engines has not been particularly active lately. A good part of the present business consists of small units for generator drive, and the most important recent shipments have consisted of two 150-kw units and two 400-hp units, the latter going to Cuba.

Views of an Electric-Crane Manufacturer on Present Industrial Conditions.—In reply to an inquiry as to the industrial outlook in his field, George A. True, president of the Northern Engineering Works of Detroit, Mich., says that raw-material supplies at present available in that line of manufacturing are of reasonably good quality and the deliveries of the same are fairly good. Current conditions in regard to the labor supply are satisfactory, but during rush seasons there is a demand for all-around crane men. The larger part of this company's force has been with it for a long time and is trained to the work. The company finds transportation conditions good, its rail shipments are handled satisfactorily, and it is able to use the parcel-post service to decided advantage. Concerning general industrial conditions, Mr. True believes that there is need for wider information as to costs and for a more uniform method of distributing overhead shop and general expense accounts over prime factory cost. He thinks that the large discrepancies in prices are largely due to a lack of such methods.

Active Fan Sales Not Yet Noticed.—The Hunter Fan & Motor Company, of 114 Liberty Street, New York, has not yet experienced the usual spring rush of business in fans. This condition is not viewed with alarm, however, as the duration of cold weather is thought to account for it in a large measure. The company's line is practically the same as it was last year, its particular specialty being a combination ceiling fan and four-lamp cluster, which finds good sale for hotel, restaurant and similar service. This unit is arranged so that in cold weather the fan blades can be removed, leaving a sightly lighting fixture.

Electric Stove Manufacturer Finds Season Dull.—The Hughes Electric Heating Company, of Chicago, which is represented in New York by the George Drake Smith Company, of 1204 Broadway, is finding local trade in its line rather dull at the present time. This is compensated for in part by activity in other sections of the country, particularly in Winnipeg and vicinity, where a good sale has been enjoyed, and by prospects for increased activity within the next month or two. The company has developed two new types of electric ranges with ovens placed above the cooking surface, but local energy rates have been a bar to any extensive sale of these ranges.

Russian Tires for Electric Vehicles.—Everett P. Stroup gave a talk on pneumatic tires for electric vehicles at the luncheon of the Chicago Section of the Electric Vehicle Association on April 7. He said that resiliency is the most important characteristic of electric-vehicle tires, as it economizes the consumption of energy. He described the Prowodnik pneumatic tires made in Riga, Russia, and contended that they are particularly adapted for electric-vehicle use owing to the fact that the body of the tire is made up of a peculiar fabric, close-woven yet elastic. These tires are now under test by the Baker Motor Vehicle Company, of Cleveland. Foreign tires pay a customs duty of 10 per cent of their value as manufactured rubber goods. Mr. Stroup said that there is no likelihood that the Prowodnik tires will ever be made in the United States, although they are imported by a New York company.

Electric Dish Washer Being Marketed.—The Electric Dish Washer Company, Inc., of 42 Pearl Street, Buffalo, N. Y., was formed recently to manufacture and sell the "Geyser" electrically operated dish-washing machine. This apparatus is made in two sizes, the smaller, or single, machine being intended for family use and the larger, or double, one for use in hospitals, sanitariums, restaurants and similar service. Both types are self-contained units of non-rusting metal construction throughout, with connections for hot-water supply and electricity. The company is planning to market the machines through the electric light and supply companies, architects and builders throughout the United States. In the small and medium-sized cities it is planned to give exclusive sales agencies. Mr. Eugene Cary, of Niagara Falls, N. Y., is president of the new concern; Mr. Richard Cary, formerly with the International Acheson Graphite Company, is its vice-president and sales manager, and its treasurer is Mr. George W. Hewitt, formerly connected with the Stone & Webster Engineering Corporation.

New England Specialty Manufacturer on Present Conditions.—The Blake Signal & Manufacturing Company, of Boston, Mass., maker of insulated wiring staples, railway signals, tube flux and compressed cleats, finds the present conditions in the raw material and labor markets satisfactory, and its president, Edmund J. Burke, states that in his opinion the parcel-post service has been a great benefit. He thinks the present freight rates ample for the service rendered and that the ruling of the railroads that their minimum charge is their first-class rate per 100 lb. is unreasonably discriminatory against small shipments.

Some Interesting Results of a Power Census in Brooklyn.—For some time the need has been felt for a more accurate knowledge of the extent to which electricity is used in Brooklyn for motor purposes and of the classification of this use by industries. Finally, to obtain this information the Edison Electric Illuminating Company of Brooklyn undertook a census limited to consideration of plants where 25 hp or more is in use for industrial purposes. Because of insufficient data on them sixty-five plants were omitted from the final summaries. Out of the total of 847 plants, 245 have installations ranging from 25 hp to 50 hp, 412 have installations ranging from 50 hp to 200 hp, and 190 use over 200 hp. The aggregate for the 782 plants considered was found to be 110,042 electrical hp, in use in forty-one different industries. Iron foundries were found to be in the lead in the number of plants using electricity, and they were followed by the wood-turning, stone-cutting, varnish and paint, furniture and provision industries, in the order named. Rated according to the amount of energy used, the first six industries were rope-making, machinery, paper, varnish and paint, chemicals and clothing. Within an area of 4 square miles in the busiest part of Brooklyn there are 281 plants with installations of over 25 hp each, seventy-two of which have over 200 hp in use.

Electrical Manufacturing Conditions in the South.—A Southern company making electric motors has given out a statement of the conditions in that line of work in its own territory. This company has in the past found some difficulty in obtaining satisfactory supplies of sheet-iron stampings for armature and field cores, but at present it has a connection which gives full satisfaction in this respect and it has found recent conditions in the copper market favorable. In the locality where its factory is placed this company has difficulty in securing plenty of first-class machinists, but all of the employees in its winding department have had to be specially trained by it for that service. The greatest difficulty experienced is in getting intelligent young men for its testing department. The company in question is not of sufficient size to undertake extensive educational work in order to improve the efficiency of its force. Express service in this maker's experience has been very poor, and the parcel-post service has replaced it in a large measure. The railroad service afforded to the company in question has been entirely satisfactory, and it strongly favors a general increase in freight rates for the railroads, believing that the latter are not now paid enough in view of increased labor and material costs.

Recent Westinghouse Orders Indicate Activity in Mining Industry.—A number of important orders have been received recently by the Westinghouse Electric & Manufacturing Company for apparatus to be used in the metal-mining industry. Among the more important of these orders are the following: A twenty-four-panel switchboard for the new Clarkdale smelter of the United Verde Copper Company; two 55-hp direct-current, back-geared motors for operating Stillwell-Bierce converters at the plant of the El Paso (Tex.) Smelting Company; six 150-kva transformers for the Washoe smelter and fourteen alternating-current motors, aggregating 290 hp, for driving mine-ventilating fans on the properties of the Anaconda (Mont.) Copper Mining Company; one 4-ton bar-steel electric locomotive for tandem operation with a similar locomotive previously furnished to the National Copper Mining Company, of Wallace, Idaho; one 5½-ton storage-battery locomotive for 30-in. gage, equipped with two type V-50 motors and sixty-eight cells of Westinghouse type A-10 battery, and two 18-ton bar-steel electric locomotives for underground and surface work at the mine of the Alaska Gastineau Mining Company, Juneau, Alaska. The latter units were specially designed for low height in order to permit them to enter the mine. The Utah Copper Company, Magna, Utah, has lately placed orders with the Westinghouse company for three 100-kw transformers, two 50-kw motor-generator sets, with switchboards, and four 15-hp slow-speed, vertical motors for direct connection to agitators, used in the oil flotation process. This is a new application, specially developed by the manufacturer after considerable experimentation. The Magna Copper Company, Superior, Ariz., has ordered from the same concern nine squirrel-cage induction motors, with a total rating of 267 hp and transformer capacity of 90 kva, for operating its copper-concentrating mill now under construction. Energy for this plant will be supplied from the Roosevelt Dam power project.

Electric Heating Apparatus to Be Sold at Half Price for One Week.—As part of its merchandising plan, the Hotpoint Electric Heating Company is planning a "sale week" for its latest cooking appliance from May 11 to 16, inclusive, during which time this piece of apparatus can be purchased at any of the company's distributing points in the country at half price. This is the fourth annual special sale feature that the Hotpoint company has inaugurated, the previous sales being for one day only. Accompanied by extensive magazine advertising, large poster displays and circularizing of dealers, this special sale seems to produce satisfactory results from the standpoint of the manufacturer. The device to be offered at the coming sale is the Hotpoint "El Glostovo," an exposed-coil-type heating unit, with a polished metal reflector below the coils and a grill above them, adapted to the ordinary cooking utensil of any character.

Action Imminent on Electric Bus System for New York.—Some time ago preliminary hearings were held on the application of the People's Five Cent Bus Line for franchises covering the operation of an extensive electric bus service in New York City. The main details concerning this proposed system appeared in the July 19, 1913, issue of the *Electrical World*. During the last few days information was obtained from Mr. E. P. Hulse concerning the status of the project at the present time. He stated that on Nov. 13 last the matter was considered by the Board of Estimate and Apportionment and by that body referred to its franchise committee. Mayor Kline, owing to his limited tenure of office, made no attempt to push the matter, and the franchise committee of the new administration was not announced until early in February and has not been so far officially convened. Mayor Mitchel, chairman of this committee, has given notice that the project is receiving his attention, and non-official expressions of interest in the plan have been obtained from President McAneny of the Board of Aldermen and from Borough President Mathewson of the Bronx, the other two members of the franchise committee. Mr. Hulse believes that the committee has an expert investigating the problem and that his findings will have an important bearing on the decision of the committee and of the Board of Estimate as a whole.

NEW YORK METAL MARKET PRICES

	Apl. 7		Apl. 14	
Copper:	Bid	Asked	Bid	Asked
Standard spot*	13.87½	14.37½	13.50	14.20
	Selling Prices		Selling Prices	
	£ s d		£ s d	
London, standard spot*	65 15 0		64 5 0	
Prime Lake	14.75	to 15.00	14.62½	to 14.87½
Electrolytic	14.45	to 14.55	14.30	to 14.40
Casting	14.25	to 14.35	14.10	to 14.20
Copper wire base	15.75	to 15.87½	15.75	to 15.87½
Lead	3.80		3.80	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter	7.00		7.00	
Spelter, spot	5.32½	....	5.25	....
Tin, spot	36.55	to 36.85	36.45	to 36.75
Aluminum:				
Prompt delivery	18.00	to 18.25	18.00	to 18.25
Future	18.00	to 18.25	18.00	to 18.25

***OLD METALS**

Heavy copper and wire	13.62½	13.62½
Brass, heavy	8.62½	8.62½
Brass, light	7.62½	7.62½
Lead, heavy	3.80	3.80
Zinc, scrap	4.25	4.25

***COPPER EXPORTS**

Total tons to Apl. 14 ..... 13.131

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Jersey Power Company Extension.—The construction of a new transmission line for the Jersey Power Company, a subsidiary of the Atlantic Gas & Electric Company, which has been authorized by the Board of Public Utility Commissioners of New Jersey, will, it is expected, reduce operating costs. The supply of power available for the Dover and Bernardsville section will be increased and officials of the company anticipate considerable new business as the result of the completion of the new line within the next four or five weeks. The new line will extend from Boonton, N. J., via Fox Hills to Millbrook and Dover, and from Dover to Wharton, including a branch on that part of the Rockaway line extending from Fox Hills to Millbrook, a total of 15.25 miles.

Lackawanna & Wyoming Valley Power Operations.—The report of the Scranton & Wilkes-Barre Traction Corporation refers to operations of the subsidiary Lackawanna & Wyoming Valley Power Company. Earnings from the sale of energy were $98,426, of which $88,999 was received from the Lackawanna & Wyoming Valley Railroad. This shows an increase in energy sold to commercial customers of $2,394. A decrease of $726 in operating expenses is due to a reduction in the cost of fuel per kilowatt-hour. W. E. Higgins, vice-president and general manager, states that additions, betterments and renewals mentioned in the report of last year were carried to a finish and a depreciation reserve was established on July 1 to cover apparatus charged to capital account. There is being charged up the sum of $100 a month, which will cover the cost in about fourteen years. The output for 1913 was 11,575,944 kw-hr., as compared with 11,279,972 kw-hr. in 1912 and 12,096,551 kw-hr. in 1911.

Consolidation of Properties in Ohio.—Authority has been granted by the Public Utilities Commission of Ohio to the Ohio Light & Power Company to issue $2,255,000 bonds, to be sold at not less than 85. The proceeds are to be used for the purchase of electric light and power plants in nine cities of Ohio, as well as to retire $800,000 outstanding bonds. The commission stated that in approving this application it is not approving valuations fixed on the properties purchased or rates that have been established upon which the valuations are believed to have been partially based. The plants purchased are the Fremont Yaryan Company, the F. W. Swezey property at Fostoria, the Licking Light & Power Company of Newark, the Frank B. Ball Electric Light Company of Mount Vernon, the Lancaster Electric Light Company, the Logan Light & Power Company, the George M. Tidd property at New Lexington, the People's Electric Light & Power Company at Shawnee and New Straitsville, and the Perry Electric Company at Crooksville.

United Railways Investment Company Power Development.—During the year 1913 the United Railways Investment Company had a total income of $2,134,224, of which $1,998,849 was received as dividends on stocks owned. Total expenses were $63,727. Charges for interest amounted to $1,164,159. Net income for the year was $906,338. The report includes the statement of income of the Sierra & San Francisco Power Company for the year. Gross earnings of this company were $1,088,774. Operating expenses and taxes were $506,796, leaving net earnings of $581,978. Deductions for interest on the first mortgage bonds and second mortgage bonds, series A, and other cash charges, less credits, were $373,594, leaving a balance of $208,384. There was payable as interest on the second mortgage bonds, series B, under the terms of the indenture, $369,440. The sum of $5000 was written off for depreciation. The excess of the interest and depreciation charges over the amount applicable was $166,056. Mason B. Starring, the president, referred in the annual report to stockholders to the fact that during the year the Sierra & San Francisco Power Company suffered from shortage of water for its hydroelectric plant. This forced the company to fall back on its steam generating plant. This involved additional expense. The demand upon the company for energy by the United Railroads of San Francisco increased 5.56 per cent. Outside of the contract with the United Railroads the gross earnings of the company from business with the general public increased to the amount of 39.31 per cent.

Operations in the Puget Sound District.—Results of operation of the Puget Sound Traction, Light & Power Company and its subsidiary companies for the calendar year 1913 show total earnings of $8,613,599, an increase of 3.6 per cent over the preceding year. Earnings of the light and power department were $2,244,705, an increase of $67,162, or 3.1 per cent, over 1912. The Stone & Webster Management Association, the general manager of the property, states in the report to shareholders that the increase in gross earnings is very gratifying owing to the fact that business conditions in the Pacific Northwest during 1913 were but fair. Operating expenses increased 2 per cent while taxes showed an increase of 25.6 per cent owing to greatly increased tax rates brought about by many public improvements, some of which will ultimately benefit the company. Owing to the growth of the light and power business during the year, a large number of short line extensions were made and new meters and transformers were installed to care for this additional business. The report says that 1914 opens with business sentiment much more hopeful in the Northwest than it has been during the past year, although no great activity in general business is looked for until well into the year. Any improvement in general business conditions will have a direct effect upon the business of the companies. Already the railway department earnings are showing large increases over the early part of 1913. It is expected that the light and power department results for 1914 will be very gratifying.

Canadian Westinghouse Company Operations.—The tenth annual report of the Canadian Westinghouse Company, Ltd., covering the year ended Dec. 31, 1913, shows that the net earnings were $1,002,618. Deductions were as follows: Dividends, 9 per cent, $445,027; bank interest, $28,700; reserve for insurance fund purposes, $50,000; written off property and plant account, $250,000; total, $773,727. The balance was $228,891, which was added to the surplus, making a total surplus as of Jan. 1, 1914, of $1,531,491. The report to stockholders, signed by H. H. Westinghouse, vice-president, calls attention to the deduction from property account and says that it follows the company's established prudent course in regard to depreciating the book value of the physical properties when opportunity offers in prosperous years. The cost of the year's product absorbed all expenditures for maintenance and replacements and for engineering development. In speaking of business conditions during the year Mr. Westinghouse states that the year opened with a good volume of orders brought forward from 1912 and with a satisfactory influx of new business during the earlier months, which together carried the year's shipment to a new maximum notwithstanding a falling off in activity during the closing months. The later reduced rate of activity was the company's share in the widespread and cumulative curtailment of trade which, starting in the West, had by the end of the year made its influence felt by practically every industry in Canada. Consequent reduced forces and shortened hours of manufacture operated to reduce somewhat the ratio of profit. The diminution in the receipt of orders was accompanied by little if any cessation in activity of the departments having to do with inquiry and quotation. This with the growing tendency to easier money conditions was the favorable feature at the time of the report. A tract of land containing 35 acres was acquired in the West End of the city of Hamilton. This is suitable ultimately for an extended general plant, but it was utilized in part immediately for the erection of an improved foundry. The construction of this building is far enough advanced to make it available some time during the coming summer or autumn.

Annual Report of the Philadelphia Electric Company.—Gross earnings of the Philadelphia Electric Company in the calendar year 1913 amounted to $7,815,615, an increase of $764,118, or 10.8 per cent, over 1912. The fourteenth annual report, issued to stockholders, shows in one item all operating expenses, taxes, fixed charges and depreciation, for which $5,887,372 was expended. This was an increase of $502,065, or 9.3 per cent, over 1912. The net income remaining applicable to stock dividends after the deductions mentioned was $1,928,243 in 1913, as compared with $1,666,189 in 1912. Cash dividends aggregated $1,180,815, as compared with $974,669 in 1912. The surplus from the operations of 1913 amounted to $747,428, as against $691,520

in 1912. The surplus at the beginning of the year was $1,818,913. With the surplus for the year the total surplus was $2,566,341. A stock dividend of $1,499,265 was paid on Dec. 1, 1913, and charged to surplus, leaving the total surplus as of Dec. 31, 1913, at $1,067,076. Charges to construction account during the year aggregated $3,382,064. This was divided among the various departments as follows: Aerial, $458,246; underground, $414,175; electrical, $965,716; meters, arc lamps and transformers, $208,719; boilers, engines and steam apparatus, $473,230; real estate and buildings, $383,107; miscellaneous, $478,871; total, $3,382,064. The total number of consumers on Dec. 31, 1913, was 52,085, an increase of 6958. The total commercial connected load was 3,127,456 standard 50-watt lamps in addition to the current supplied to street-railway companies for 37,467 electric hp, making a total increase in the connected load of 627,672 50-watt lamps. Joseph B. McCall, the president, calls attention to the fact that a reduction of $65,120 was made in the contract with the city of Philadelphia for street lighting for 1914, making the average rate $84.35 per light per year without taking into consideration the amount of free current supplied to the city. The Philadelphia company will extend its Christian Street station and install two additional units, one of 40,000 and one of 46,000 electrical hp, which will be the final installation in this station and will make the ultimate station capacity over 200,000 electrical hp. Anticipating future demands, the company has purchased a new site of about 8½ acres on the Delaware River for $400,000 as the site for the next generating station in Philadelphia. The balance sheet as of Dec. 31, 1913, shows $450,000 notes payable. The insurance fund, which was not included in the figures of the report, contains $625,288 in cash and securities, market value.

Earnings of Southern California Edison Company.—On account of unexpected changes in the business situation, gross earnings of the Southern California Edison Company were not so large in 1913 as had been anticipated at the beginning of the year. Gross earnings reached a total of $4,779,279, an increase of $441,838, or 10.2 per cent over 1912. Operating expenses were $2,430,290, as compared with 2,329,085 in the preceding year. Net earnings aggregated $2,348,989 in 1913, an increase of $340,634, or 11.9 per cent, over 1912. Charges for interest and amortization last year were $813,969, while in 1912 they were $708,796. The balance was $1,535,020 in 1913, an increase of $235,461 over 1912. Against the balance there were charged as reserves for depreciation $700,000 in 1913 and $650,000 in 1912. The surplus remaining was $835,020 last year, as compared with $649,559 in 1912. Dividends were declared on both the common and preferred stock at the rate of 5 per cent last year, or a total of $620,000, leaving a balance of $215,020 for the surplus account. In the annual report to stockholders W. A. Brackenridge, vice-president and general manager, says that since the last report the generating capacity has increased about 27,000 hp, making a total capacity of 119,800 hp. During the present year changes are contemplated at Kern River No. 1 hydraulic plant. This will result in an additional output of approximately 5000 hp. Permits have been issued for the development of four additional power plants on the Kern River. The grants specified a period of twelve years for the completion of a possible development of 111,000 hp. Kern River No. 3 plant provides for an installation of 33,000 hp, and as it is the most desirable in point of amount of power and cost of construction, this has received first consideration, and work on this project is now in progress. The steel-tower transmission line completed in 1912 from Long Beach to Los Angeles and Colton has given entire satisfaction. Mr. Brackenridge refers to the development of water-power by the city of Los Angeles. Little progress has been made on the project of the city to deliver power developed along the line of the Los Angeles aqueduct. Negotiations are pending between the city officials and the companies operating within the city for the purchase or lease of the distributing systems by the city, with a view to satisfactory arrangements for an equitable and economical utilization of the power proposed to be generated by the city. The number of incandescent lamps, 50-watt equivalent, installed on Jan. 1, 1914, was 1,634,185, as compared with 1,436,617 one year previous. The number of electric meters was 96,851, as compared with 80,995 one year before. The number of motors was 7485, as compared with 6452. The aggregate horse-power of the motors was 118,610 on Jan. 1, 1914, as compared with 94,478 one year previous. The number of municipal arc lamps was 1043, as compared with 966. The number of commercial arc lamps was 1119, as compared with 1530. The certificate of Price, Waterhouse & Company, covering the profit and loss account, states that miscellaneous charges aggregating $67,389 net, for which no provision was made in the expense accounts prescribed by the Railroad Commission of California, were charged direct to surplus.

Northern Texas Bonds Offered.—Collateral trust and 5 per cent gold sinking-fund bonds of the Northern Texas Electric Company to the amount of $1,000,000 are being offered by Parkinson & Burr and Estabrook & Company, of Boston and New York. The bonds are part of an issue dated Jan. 1, 1910, and due Jan. 1, 1940. The circular letter of the bankers offering the bonds includes a letter describing the property, written by Henry G. Bradlee, president of the Stone & Webster Management Association.

Earnings and Prospects of the Montana Power Company.—Gross earnings and other income of the Montana Power Company, covering operations of the Great Falls Power Company, the Thompson Falls Power Company and the Montana Reservoir & Irrigation Company, for the year ended Dec. 31, 1913, amounted to $3,539,198. This is an increase of $516,234, or 17.1 per cent, over the preceding year. The annual report issued to stockholders shows that of the amount stated as gross earnings $7,036 was received as interest from banks and outside sources. Operating expenses and taxes in 1913 aggregated $1,117,774. This compares with $974,828 in 1912. Net earnings in 1913 were $2,421,424, as compared with $2,048,136 in 1912. Interest charges in 1913 were $901,478, while in 1912 they were $1,252,913. The surplus over charges therefore was $1,519,946 in 1913, as compared with $795,223 in 1912. Operating expenses and taxes amounted to 31.6 per cent of the gross earnings in 1913 and to 32.2 per cent in 1912. The total charges for interest included $36,980 bond discount. President John D. Ryan states in the report that the growth in business has been general over the entire system. Practically one-quarter of the new business has been done in contract with mining, smelting and railroad companies and three-quarters in general commercial power and lighting. The number of customers on the books is 26,620, or a gain of 3211 during the year. There was an increase in the connected load of 18,568 kw over 1912. Mr. Ryan says that the outlook for a steadily increasing business for 1914 is very bright. It is hoped to have the Great Falls hydroelectric plant in partial operation early in 1915 and to complete it during that year. Until that plant can deliver power to the system, however, the net earnings are not likely to show the usual proportion of increase, for the reason that the hydroelectric power now developed and available is sufficient to take care only of existing business. The growth during the year may necessitate operation of one of the steam reserve plants during the last few months of the year, and in that event the extra expense of steam operation may result in a somewhat smaller rate of increase in net earnings. Mr. Ryan says that development of water-powers in Montana and transmission of cheap electric power to sections heretofore considered inaccessible or too remote to be reached at reasonable cost are materially aiding the prosperity and development of the State. There are many possibilities in the direction of irrigation by pumping which will tend to the upbuilding of communities. The Great Falls plant will have a capacity of 80,000 hp. It is expected that the hydroelectric plant at Thompson Falls on Clark's Fork of the Columbia River will be in partial operation at the end of 1915 and will be completed in 1916. A capacity of 40,000 hp will be installed at this plant. At the end of last year the company had a total capacity of 102,080 hp, of which 94,000 hp was obtained from hydroelectric plants and 8080 hp from steam reserve plants. Of the total of $75,000,000 of common stock authorized, $27,057,600 has been issued and is entitled to share in dividends and $22,500,000 has been issued but is not entitled to share in dividends until certain new hydroelectric plants are completed, and then only on gradual instalments of stock each year.

Business Notes

The Allis-Chalmers Manufacturing Company has moved its Atlanta (Ga.) office to 1104-6 Healy Building, effective April 1.

The Fort Wayne Engineering & Manufacturing Company has recently opened a New York office at 110 West Thirty-fourth Street, in charge of Mr. O. L. Rimoldi.

The Wagner Electric Manufacturing Company, of St. Louis, Mo., has opened an office in Suite 524, Syracuse University Block, Syracuse, N. Y., in charge of Mr. J. W. Bryant.

Meikleham & Dinsmore.—W. H. Padgett, of Philadelphia, has recently become associated with Meikleham & Dinsmore, bankers, New York, his headquarters being at 1421 Chestnut Street, Philadelphia.

The Asbestos Protected Metal Company, of Beaver Falls, Pa., has moved its New York office to more commodious quarters at 52 Broadway. P. M. Stewart continues as district manager in charge of this office.

Elliott H. Whitlock has opened an office at 1506 West 112th Street, Cleveland, Ohio, as consulting and efficiency engineer and carbon expert. Mr. Whitlock has had eighteen years' experience in the carbon industry and in plant management in other lines.

The Dearborn Chemical Company, of Chicago, Ill., has transferred its Southeastern branch office from Birmingham, Ala., to 1407 Candler Building, Atlanta, Ga., where C. H. Everett and J. F. Boutelle, representing the Dearborn company in that territory, will have their headquarters.

The Alpha Electrical Supply Company, of 116-118 West Twenty-ninth Street, New York, has been purchased by Michael Coleman, who will conduct the business hereafter at the same address and with increased facilities for taking care of its customers' wants. The change involves no organization changes.

Munning-Loeb Company.—The interest of Mr. W. L. Loeb in the Munning-Loeb Company, of Matawan, N. Y., maker of electroplating apparatus, has been purchased by Mr. C. E. Watrous, who is now vice-president of that concern. Mr. Watrous previous to this connection was manager of the New York office of the Cutler-Hammer Manufacturing Company.

The United States Light & Heating Company has moved its Chicago branch sales office to 2335 State Street, bringing it into the same building with its service station. The railway department at this office is under the supervision of H. A. Matthews, while R. E. Stuntz has charge of the battery and starter department, and H. M. Emerson looks after the service department.

The Roller-Smith Company, 203 Broadway, New York City, announces that, in addition to its branch offices at 740 Monadnock Block, Chicago, and 711 Williamson Building, Cleveland, it now has the following representatives: The Tompkins-Stoddard Company, 77 Franklin Street, Boston; H. I. Shire, 1310 Majestic Building, Detroit; the W. W. Geisse Company, McKnight Building, Minneapolis; John S. Black, 908 Hennen Building, New Orleans; G. L. Priest, 229 Sherlock Building, Portland, Ore., and the H. B. Squires Company, 579 Howard Street, San Francisco.

Brown, Williams, Bell, Hanson & Boettcher, Chicago patent lawers well known to electrical men, announce a dissolution of partnership by mutual agreement to take effect on April 1. Charles A. Brown, Harvey L. Hanson and Arthur H. Boettcher will continue in partnership in the practice of patent and trade-mark law at 1550 Monadnock Building, 53 West Jackson Boulevard. Lynn A. Williams will continue in practice in the same branches of the law, with offices in the same building. Albert C. Bell will continue in practice in partnership with Henry M. Huxley, with offices at 208 South La Salle Street.

The Freeman-Sweet Company, of 538 South Dearborn Street, Chicago, which does a general electrical contracting business, has established a new department for the purpose of undertaking underground electrical construction work. For a number of years the company has done interior and overhead work and is now prepared to lay conduits and cables underneath the ground. Ornamental street-lighting systems, manhole construction and expert cable splicing will be among the classes of work undertaken by the new department. Ernest Freeman, the president of this company, is also president of the National Electrical Contractors' Association of the United States.

New Industrial Companies

The Railway Electric Manufacturing Company, of Chicago, Ill., has been incorporated by Max Zabel, Otto M. Wermick and H. A. Jones. The company is capitalized at $25,000 and proposes to manufacture and deal in new mechanisms.

The Dennison & Buck Company, of Newark, N. J., has been incorporated with a capital stock of $50,000 to manufacture and deal in electrical goods. The incorporators are I. Simon, B. Strauss, of New York, N. Y., and M. Cohen, of Brooklyn, N. Y.

The Pfanstiehl Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $300,000 to manufacture motors, generators, etc. The incorporators are H. E. Latter, W. J. Maloney and O. J. Reichard, of Wilmington, Del.

The American Model & Instrument Company, of Worcester, Mass., has been incorporated by W. W. Johnson, J. V. Critchley and C. J. Rohland, of Worcester, Mass. The company is capitalized at $50,000 and proposes to manufacture electrical and mechanical devices.

The Sterling Switchboard Company, of Camden, N. J., has been incorporated with a capital stock of $125,000 by J. S. Low, F. N. Humphreys, Jr., of Merchantville, and W. A. Forman, Jr., of Camden. The company proposes to manufacture electrical machinery, switches, etc.

The Fisk Battery Box Company, of Cleveland, Ohio, has been incorporated by A. W. Thomas, E. M. French, L. A. Pejau, J. L. Fairbanks and William E. Patterson. The company is capitalized at $10,000 and proposes to manufacture and deal in electrical equipment of all kinds.

The Rochester Electric Contracting Company, of Rochester, N. Y., has been chartered with a capital stock of $10,000 to do a general contracting and electrical engineering business. The incorporators are Richard Finucane, Bernard E. Finucane and John J. Finucane, of Rochester, N. Y.

The Rollings Company, of Boston, Mass., has been granted a charter with a capital stock of $10,000 to manufacture electrical fixtures. The incorporators are William L. Everett, of Auburndale; William H. Locke, of Everett, Mass.; Paul D. Everett, of Boston, Mass., and Ralph G. Locke, of Everett, Mass.

The Lycoming Transit Company has filed articles of incorporation under the laws of the State of Delaware for the purpose of manufacturing electrical apparatus and machinery. The company is capitalized at $25,000, and the incorporators are J. L. Wolcott, J. H. Hughes and O. M. Roach, of Dover, Del.

The Automatic Ignition Company has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $600,000 and proposes to manufacture spark plugs, ignition apparatus, motors, etc. The incorporators are C. E. Wayman, S. A. Braden and E. J. Stebick, of Pittsburgh, Pa.

The Progressive Electric Welding Company, of New York, N. Y., has been incorporated with a capital stock of $30,000 to manufacture and deal in boilers and dynamos and to do also welding and repairing work. The incorporators are E. Von der Heyde and E. Wellesky, of New York, N. Y., and C. L. White, Jr., of Passaic, N. J.

The National Transportation & Electric Service Corporation has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $2,500,000, to manufacture and sell trucks operated by electricity for transportation of passengers, freight, etc. The incorporators are H. E. Latter, W. J. Maloney and O. J. Reichard, of Wilmington, Del.

Trade Publications

Lightning Arresters.—Bulletin 45600 has been issued by the General Electric Company to describe aluminum lightning arresters for use in connection with railway signal circuits.

Ball Bearings.—The Hess-Bright Manufacturing Company, of Philadelphia, Pa., has just issued a series of sheets showing diagrammatically, with accompanying descriptions, the various types of vertical, horizontal and thrust bearings in which its ball bearings are used.

Distributing Boards.—A large mailing card is being sent out by the Metallic Seamless Tube Company, Ltd., Corporation Street, Birmingham, Ala., referring to its fuse and distributing boards. The illustration shows a "double-door" type. The card contains price list.

Electric Signs.—A small folder issued by Harvey Deschere & Company, 50 Church Street, New York, gives data relating to their Argus miniature electric signs. Miniature tungsten-filament lamps, rated at 4 volts, are used in these signs, and the letters are interchangeable.

Anchors.—The Faultless Anchor Company, Fostoria, Ohio, has brought out a small folder in which four illustrations of its "Faultless" anchor are shown and the four-fin and the two-fin types described. Unusual holding power is claimed for this anchor, which can be installed without any special tools.

Electric Tools.—The Stow Manufacturing Company, Binghamton, N. Y., has issued a number of illustrated leaflets referring to its electric tools, among them leaflets on an electric bench grinder, electric breast drill, tool post grinder and flexible boring machine. A separate folder has been issued on the company's portable tools.

Condulets.—House-number condulets made by the Crouse-Hinds Electric Company, Syracuse, N. Y., are the subject of an illustrated four-page leaflet. These condulets can be so mounted as to show the house number clearly and at the same time throw ample light on the walk. The advantages of such a device for house-numbering are obvious.

Fans.—The 1914 fan catalog of the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York, is being distributed. Almost every fan requirement seems to have been provided for. The publication shows numerous illustrations of direct-current and alternating-current fans in desk, ceiling, column and exhaust types.

Portable Drill.—The general construction of the model D electric portable drill manufactured by the Temco Electric Motor Company, Leipsic, Ohio, is described and illustrated in a large folder recently issued by the company. This drill operates on either direct current or alternating current and can be attached to any ordinary drop cord. Its specifications are given in the circular.

Strain Insulators and Clamps.—Bulletin A4200, issued by the General Electric Company, is devoted to strain insulators and strain clamps suitable for insulating and supporting power-house wiring and overhead distributing cables and wires. The construction of these insulators and clamps is illustrated and described, and the bulletin contains also catalog numbers and prices of the various articles.

Meters.—"Esterline Efficiency Ideas" is the title of Folder No. 312, recently sent out by the Esterline Company, Indianapolis, Ind. A full description of the meters and a number of illustrations showing various types are given. The outside front and back covers contain a full-size Esterline graphic meter chart. New sections for the company's loose-leaf graphic meter data book and price list have also been issued recently.

Electric Percolator.—The Hotpoint Electric Heating Company, Ontario, Cal., has added another broadside to its advertising literature addressed to dealers. The present one refers to the company's new El Perco aluminum percolator. Attention is called to the national advertising to be given to this coffee-pot. This publicity will educate the public and create for this household necessity a demand by which the dealer will benefit.

Matthews Telefault.—W. N. Matthews & Brother, 3777 Forest Park Boulevard, St. Louis, Mo., have issued a large broadside which contains on one side a full-size picture of the "telefault," an instrument for finding faults. A complete description is given of the device and a trial proposition offered to any telephone or cable using company. The reverse side of the sheet contains a number of testimonial letters from satisfied users.

Steel Lockers and Shelves.—Terrell's Equipment Company, Grand Rapids, Mich., has issued an illustrated eight-page folder calling attention to its steel wardrobes and lockers, steel cupboards for storing stationery, valuable stock, supplies, tools, etc.; sectional steel shelving for vaults and storerooms, steel stools and steel chairs, etc. The Eastern representative of the company is Stanton M. Child, 806 Evening Post Building, 20 Vesey Street, New York.

Outdoor Substations.—The Delta-Star Electric Company, of 617-631 West Jackson Boulevard, Chicago, has reprinted in pamphlet form, by special permission, the address of its president, Mr. H. W. Young, on "Moderate-Capacity Outdoor High-Tension Substations." This paper was read before a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers on Dec. 29, 1913.

Devices.—"Electric Household Helps" is the title of a little folder (No. 4197) issued by the Westinghouse Electric & Manufacturing Company, illustrating the application of electrical devices in the household. The reading matter describes the cooking of breakfast, dinner, supper and luncheon, and also treats of the uses of these devices in the boudoir, sewing room and other rooms about the house. A complete price list is included, and the number of watts consumed by each device is shown.

Electric Cooking.—The new catalog of the Hughes Electric Heating Company, of 211-233 West Schiller Street, Chicago, is an interesting pamphlet, with a frontispiece portrait of George A. Hughes, the president of the company, and an attractive cover in colors. Mr. Hughes also contributes a foreword under the title "Life Is Just What You Make It." The advantages of electric cooking are described, and there are descriptions of the various types of Hughes electric stoves, ranges and hot plates. A number of interesting testimonial letters are given.

Lamps.—The fifth edition of the Western Electric Company's copyrighted bulletin, entitled "How to Figure Illumination—Also a Complete Catalog of Sunbeam Mazda Lamps," is just off the press and is being distributed. This bulletin gives complete information for planning the illumination of interiors. Numerical tables necessary in laying out lighting installations for different classes of business are given in this bulletin, as well as other illumination data, such as figures giving efficiencies of lamps and comparative efficiencies of various types of reflectors, both glass and steel.

Grounding of Electrical Systems.—The Fairmount Electric & Manufacturing Company, Philadelphia, Pa., has issued in pamphlet form Mr. H. P. Liversidge's paper on "Grounding of Electrical Systems" which was presented at the eighteenth annual convention of the International Association of Municipal Electricians. The paper discusses briefly the practical side of the subject, as it relates to the methods which have proved most effective. Several diagrams of connections are shown, as well as a photograph of an improved type of grounding device for use on electrical circuits.

Diesel Engines.—The Diesel engine is the subject of an exceptionally well-prepared publication, both as to contents and mechanical features, recently brought out by the Busch-Sulzer Diesel Engine Company, St. Louis, Mo. A brief history of the engine is followed by chapters on the efficiency, economy, life, construction, operation and fuel of this modern prime mover. Its application to various lines of industry is described, and Diesel installations in twenty-six states of the Union are illustrated. The publication is printed with brown ink on lusterless paper, artistically inclosed within brown pasteboard covers, and is a worthy example of fine trade literature.

Personal Mention

Mr. E. J. Cooper, of Edwardsville, has been elected superintendent of the Catawissa (Pa.) municipal lighting plant.

Mr. E. R. Adams has succeeded Mr. W. R. Stewart as superintendent of the municipal lighting and water plant at Blakely, Ga.

Mr. R. U. Steelquist has been appointed manager for the Oregon Power Company at Corvallis, succeeding Mr. A. L. Martin, transferred.

Mr. A. E. Carpenter, of the Eastern Wisconsin Railway & Light Company, has been appointed general manager of the Lomira lighting plant.

Mr. G. W. Skow has been appointed general manager of the Coal & Gas Belt Electric Company, Huntington, Ark., to succeed Mr. L. M. Gazin, resigned.

Mr. Fred Williams has been appointed superintendent of the municipal electric light plant and water-works, Wilmot, S. D., succeeding Mr. K. Hegna, resigned.

Mr. A. L. Martin, formerly manager for the Oregon Power Company at Corvallis, has been appointed manager of the Dallas division of the company, succeeding Mr. J. L. White, transferred.

Mr. J. L. White, for several years manager of the Dallas division of the Oregon Power Company, has been transferred to Albany, Ore., as manager for the company in that city, succeeding Mr. H. E. Morton, resigned.

Mr. Newcomb Carlton has been elected president of the Western Union Telegraph Company to succeed Mr. Theodore N. Vail, who resigned as a result of the sale of stock of the Western Union company by the American Telephone & Telegraph Company. Mr. Carlton has been vice-president in charge of operation.

Mr. J. H. Stewart has resigned as superintendent and contract agent of the municipal electric-light plant of Logansport, Ind., to take charge of the electrical department of the Logansport (Ind.) Heating Company, which recently obtained a franchise to provide electrical energy to factories and homes in the rural districts.

Mr. E. H. Beil, recently connected with the engineering firm of Dodge, Day & Zimmerman, of Philadelphia, has returned to Youngstown, Ohio, and taken the position of manager of the light and power department of the Youngstown Consolidated Gas & Electric Company. Mr. Beil is a former president of the Ohio Electric Light Association.

Mr. Jean Bart Balcomb, who left Chicago to become the executive engineer of the Buena Vista Power & Irrigation Company of Andrews, Ore., and who was afterward elected its president, has assumed the additional duties of executive engineer for the Wild Horse Power & Milling Company, to have charge of the construction and operation of its hydro-electric plant, plans for which are practically completed.

Mr. Sidney Diamant has opened an office at 15 East Fortieth Street, New York, as a consulting engineer. Mr. Diamant is a graduate of Columbia University, and since 1902 has been engaged in the design and erection of steel, timber and reinforced-concrete structures, comprising office and loft buildings, warehouses, schools, public buildings, railway structures, carhouses and power plants. He was connected with the Pearson Engineering Corporation in the erection of the power stations at Necaxa, Mexico, and at Niagara Falls, Ont.

Mr. Nicholas F. Brady, president of the New York Edison Company and head of the Brady syndicate, which owns and operates a number of public utilities in various parts of the country, has been appointed chairman of the industrial committee of the Merchants' Association of New York, as successor to Mr. Henry Morgenthau, now American Ambassador to Turkey. Engaged with Mr. Brady on this committee are a number of other men also interested in public utilities as follows: Messrs. F. H. Bethell, vice-president New York Telephone Company; J. F. Calderwood, formerly of the Brooklyn Rapid Transit Company; Frank Hedley, vice-president of the Interborough Rapid Transit Company, and C. G. M. Thomas, president of the New York & Queens Electric Light & Power Company.

Mr. Dudley Farrand will next month commence his twenty-eighth year of active service in the electric-light industry. Mr. Farrand, who is a past-president of the National Electric Light Association and is general manager of the Public Service Electric Company of Newark, N. J., has had heaped upon him many honors for a man of his years. He was born and brought up in Essex County, N. J., and was educated at the Newark Academy and also attended Princeton University for a time, discontinuing his studies there because of poor health. Twenty-seven years ago he entered the employ of the Newark (N. J.) Electric Light & Power Company, which at that time was a very small organization with a connected load of approximately 150 arc lamps and 365 incandescent lamps. His position was that of general office assistant. During 1889 and 1890 the company took in two other Newark companies. These companies in due course of time and after some changes became a part of the Public Service Electric Company. Mr. Farrand's advancement has kept pace with the growth of the companies with which he has been connected for all of his business life. As general manager of the company he has supervision of the design, construction and operation of all the stations and substations of the system, which include thirty-two generating stations and fifty-six substations. The system is one of the largest in the country, the output last year being approximately 401,000,000 kw-hr. The company serves 178 municipalities with electrical energy and its lines extend from Jersey City on the Hudson River to beyond Camden on the Delaware River.

DUDLEY FARRAND

Mr. Francis Jehl, electrical engineer of the General Electric Company of Budapest, Hungary, has been decorated with the Knight's Cross of the Order of Francis Joseph by the Emperor of Austria-Hungary. Mr. Jehl has been connected with the work of the Budapest company for the past seventeen years and has been prominently identified with developments in the electrical art in Europe and America ever since the early work on the Edison electric incandescent lamp at Menlo Park, N. J. Mr. Jehl was at that time one of Mr. Edison's assistants and took part in the epoch-making experiments leading to the development and perfection of the incandescent lamp, the Edison system of electrical distribution, the Edison electric railway, etc. In 1881 he equipped and superintended the testing department of the Edison Machine Works on Goerck Street, New York, and early the next year he was sent to England by Mr. Edison to install the Edison electrolytic meter in the Holborn viaduct station, which had been constructed for the English Edison Company by Mr. E. H. Johnson, general manager, and Mr. W. J. Hammer, chief engineer. This station, which is said to have been the first established anywhere in the world, began operations Jan. 12, 1882. After equipping the meter department for the English company, Mr. Jehl went to France to undertake similar work for the French Edison Company, and about that time prepared the first book ever written upon the electric meter. He later traveled extensively in Europe, introducing the Edison electric-lighting system, and installed the lighting plant in the Brünn Theatre at Brünn, Austria. Mr. Jehl made a similar installation in Bucharest, Roumania, and in 1883 had charge of

FRANCIS JEHL

the Edison exhibit at the Vienna Electrical Exhibition. At one time Mr. Jehl was associated with the Hardtmuth Carbon Company of Austria. While in Vienna in 1899 he wrote a book on carbon manufacture and took out a number of patents upon various inventions, such as carbon economizers, continuous furnace for carbon manufacture, electric meters and a Faraday disk type of dynamo, known as the Jehl-Rupp disk dynamo. While at Menlo Park Mr. Jehl invented a very simple type of mercury pump which was extensively used for exhausting incandescent-lamp bulbs, and during his stay in Austria he established a small lamp factory in order to protect the Edison lamp patents in that country. Mr. Jehl has been a frequent contributor to the technical press both here and abroad.

Mr. C. A. Ablett, who was recently appointed general manager of the Siemens Company of Canada, Ltd., has had a wide experience as an electrical engineer in Europe and on the North American continent. He was manager of the steel works and rolling-mill department of the Siemens Brothers Dynamo Works, Ltd., London, England, and had charge of the installation of some of the largest electrical plants in European steel works. Prior to 1906 he was with the General Electric Company and was engaged in electrical work in Canada and the United States. He has contributed papers to the Institution of Civil Engineers, the Iron and Steel Institute and the Institution of Electrical Engineers and was joint author with Mr. H. M. Lyons of a paper on the "Electrical Driving of Winding Engines and Rolling Mills," read March 12 before the Canadian Society of Civil Engineers and the Canadian Mining Institute. He is an associate member of the Institution of Civil Engineers and has been made the recipient of the Bayliss and Miller prizes of that institution.

Mr. Stephen L. Coles has resigned the secretary-treasurership of the Society for Electrical Development, effective April 15. As of the same date he has joined the engineering staff of M. W. Thompson, 111 Broadway, New York City, specialist in litigated engineering matters and in reports on railroad and other large properties. Mr. Coles will devote his attention principally to electrical public utilities having problems of service, policy and competition to solve. He has grown up with the electrical industry, his first work having been with the old New England Wiring & Construction Company, of Boston, in installing an isolated electric-lighting plant at Springfield, Mass., in 1889, for the Boston & Albany Railroad. He was educated in the public schools, including the famous Woodward High School, of Cincinnati, Ohio, his birthplace. He entered the Massachusetts Institute of Technology with the class of 1891 and in his fourth year left college to become Boston correspondent of the *Electrical Review*, of which later he was managing editor for several years. Mr. Coles has been a prolific writer for the secular press on electrical subjects treated in a popular manner and is a frequent contributor to technical and engineering publications. During the past five years he has made a special study of service and public-policy questions affecting central stations. At the last annual meeting of the Canadian Electrical Association his brief paper on "Service" created a great deal of valuable discussion. In January, 1913, Mr. Coles was employed by the Harrisburg Board of Trade to make a report on the industrial conditions of Harrisburg, Pa. His work was highly commended by the local newspapers, and he received a special letter of thanks from the Board of Trade. Last summer his services were loaned by the Society for Electrical Development to the Toronto Electric Light Company, Ltd., of Toronto, Canada, to assist the executives of that company in working out certain constructive policies of importance. Since Aug. 1 last Mr. Coles has been acting secretary-treasurer and secretary-treasurer of the Society for Electrical Development and has concentrated his well-known energies on doing his share toward making the society an accomplished fact and a working reality. One of his latest efforts in behalf of the society was an article under his signature in the "Public Utilities Number" of the *Evening Post*, New York, March 30, giving data regarding the objects and formation of the society and the educational work it expects to do.

STEPHEN L. COLES

Obituary

Thomas R. Fernald, for fifty years connected with the electrical contracting house of the Seth W. Fuller Company, Boston, Mass., died suddenly at his home in Somerville, Mass., on April 8. Mr. Fernald was one of the pioneer electricians of the country and in the course of his career was occupied in the wiring of many of the most prominent buildings in America.

Sir William Whyte, formerly vice-president of the Canadian Pacific Railway and Premier of Manitoba, died in Los Angeles, Cal., April 14. Sir William Whyte was also vice-president of the Winnipeg Electric Railway Company, which owns the electric railway of Winnipeg and operates the municipal system in opposition to the municipal plant recently started in Winnipeg.

Thomas C. White, proprietor of the T. C. White Company of St. Louis, manufacturer of railway and lighting specialties, died in that city on March 22. Mr. White had been engaged in electrical manufacturing enterprises for twenty years or more, having been in business for himself for the last ten or twelve years. Before that time he was connected with the Central Union Brass Company of St. Louis.

Lincoln S. Risley, manager of the United Electric Light & Water Company of New Britain, Conn., died on April 5 of heart trouble. Mr. Risley entered the employ of the New Britain Railway & Light Company in 1893 as clerk, and soon rose to the superintendency of the company. He followed the lighting company through its various changes, when it was acquired by the late A. M. Young, and then by the New Haven railroad. When the railway and lighting interests were divorced, Mr. Risley became superintendent of the New Britain plant.

L. N. Peart, general superintendent, and J. E. Burgess, construction superintendent, of the San Joaquin Light & Power Company, of Fresno, Cal., were drowned in the San Joaquin River on March 28, when the automobile in which both were riding slid from the Crane Valley bridge. Mr. Burgess, whose body was recovered on March 31, was a graduate of the University of California and was twenty-six years old. Prior to his connection with the San Joaquin Light & Power Company he was engaged in business in Los Angeles. He was a native of Michigan.

Delancey H. Louderback, a financier who had been prominent in Chicago public utility affairs, particularly in street-railway and elevated-railway enterprises as a lieutenant of the late C. T. Yerkes, died on April 9. Back in 1888 Mr. Louderback was general manager of the Chicago Edison Company, predecessor of the Commonwealth Edison Company. Before that he had been secretary of the old Western Edison Light Company. He was also connected with telephone enterprises in the early days and was then associated with the Central Union Telephone Company. He was also at one time an officer of the Western Electric Company. Of late years he had given his attention to his real estate investments.

Maurice B. Peugnet, of St. Louis, died in Detroit on April 12, while on a visit to that city. Mr. Peugnet was a man of brilliant scientific attainments. He was born in New York City forty-three years ago and was a descendant of a noted French family. He was a graduate of the United States Naval Academy and served as an officer in the United States Navy. He took post-graduate work at Harvard and was made professor of gas engineering at that university. He was gifted with unusual inventive ability, but being a reticent man possessed of ample means and having no taste for commercial exploitation, he did not bring his inventions to the attention of the public. One of his inventions, for which he took out a patent, was an electric drill. Mr. Peugnet was much interested in automobile design and his visit to Detroit was largely to inspect the automobile factories in that city.

Construction

New England

CONWAY, N. H.—A committee has been appointed to make a contract with the Conway El. Lt. & Pwr. Co. for lighting the streets of the village, provided satisfactory arrangements can be made.

RICHFORD, VT.—The Richford Pwr. Co. has filed a certificate showing an increase of capital stock to the amount of $21,000 with the Secretary of State, the proceeds to be used for developing water-power, electric lighting, etc. The property of the company is located at Stevens Mills, about 3 miles above Richford. S. R. Boright is president of the company.

BROCKTON, MASS.—The highway commission is planning the removal of 80 arc lamps in the street-lighting system and the substitution of about 300 incandescent lamps.

FITCHBURG, MASS.—Plans are being prepared by the Putnam Machine Co., of Fitchburg, for the construction of a machine shop and power house, to cost about $300,000.

HOLYOKE, MASS.—It is reported that bids will be received by the Gas and Electric Department of the city of Holyoke, Mass., until April 21 for gem and tungsten lamps. Bids will also be received by the department until April 28 for electric and gas meters. Specifications may be seen at the office of the department. John J. Kirkpatrick is manager.

PLYMOUTH, MASS.—The proposed extension to the system of the Plymouth El. Lt. Co. is a high-tension transmission line (30 miles, 22,000 volts) running from Plymouth to Wareham and Marion. It also means a small addition to power house and the installation of a 1000-kw turbine. Contracts have been placed for all material. E. P. Rowell is manager.

RUTLAND, MASS.—At the annual town meeting held April 7 it was voted to instruct the Selectmen to enter into a 10-year contract with the Gardner El. Lt. Co., of Gardner, for lighting the streets of the town with 40 lamps of 60 cp and 45 lamps of 40 cp, at a cost of $800 per year. It was also voted to instruct the water commissioners to equip the pumping station with electrical machinery at a cost not to exceed $2,500, and to contract with the Gardner company for electricity to operate same for a period of ten years. The Gardner El. Lt. Co. has applied for a franchise here.

WAKEFIELD, MASS.—The citizens have voted to make extension to electric service on several streets in the town, and also to extend the street-lighting service into Montrose Avenue.

MERIDEN, CONN.—Preliminary plans are being prepared by the Meriden El. Lt. Co. for the installation of an underground conduit system. C. A. Learned is general manager.

WILLIMANTIC, CONN.—The Willimantic Gas & El. Lt. Co. expects to purchase material for distribution system and electrical supplies and appliances within the next few months to meet requirements. J. F. Ahern is agent.

Middle Atlantic

JAMESTOWN, N. Y.—The lighting commission has awarded the contract for construction of new boiler house and fan house at the municipal electric-light plant to S. T. Benson & Co., of Falconer, at $9,575.

MEDINA, N. Y.—Preparations are being made by the A. L. Swett El. Lt. & Pwr. Co., of Medina, to make extensive improvements to its power plant at Medina Falls, including the installation of a 450-hp generating unit, consisting of a new Morgan Smith waterwheel directly connected to a General Electric generator. The cost of the work is estimated at $6,000.

NEW ROCHELLE, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 16 for construction, complete (including mechanical equipment, interior lighting fixtures and approaches) of the United States post office at New Rochelle, N. Y. Drawings and specifications may be obtained from the above office or from the custodian of site at New Rochelle. O. Wenderoth is supervising architect.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, until April 20 for installing electric equipment in addition to and making alterations in Public School 169, on Audubon Avenue, between 168th and 169th Streets, borough of Manhattan. Blank forms, plans and specifications may be obtained at the office of the superintendent.

RICHMOND HILL, N. Y.—A contract for electric equipment for Richmond Hill High School has been awarded by C. B. J. Snyder, superintendent of school buildings, to the Doncourt Construction Co., of Flushing, at $3,444.

NEW CASTLE, PA.—An ordinance has been introduced into the Council providing for a curb lighting system on Washington Street from County Line Street to Greenwood Avenue, a distance of about a mile. The city will own the lamps and standards and will purchase electricity. Three-lamp clusters will be used except at intersection of streets, when five-lamp clusters will be used. The city engineer and electrician have been authorized to prepare plans.

PHILADELPHIA, PA.—Bids will be received until May 7 for furnishing electric arc street lamps, which includes maintenance service complete with use of equipment for year 1915. Morris L. Cooke is director of public works

BOONTON, N. J.—The Jersey Pwr. Co., Boonton, has closed a contract with the Morris County Traction Co., of Morristown, to furnish electricity to operate the electric-railway system of the traction company, extending from Boonton to Lake Hopatcong and from Danville to Morris Plains, a total distance of about 25 miles, for a period of ten years.

BUTLER, N. J.—The Council has decided to submit to the voters in the near future the proposal to issue $35,000 in bonds for the installation of a municipal electric-light plant.

LAUREL, DEL.—Within the next 30 days the Sussex Lt. & Pwr. Co., of Laurel, expects to purchase 180 ft. No. 4, three-wire submarine cable to carry 13,000 volts. H. L. Richardson is superintendent.

BALTIMORE, MD.—Plans have been prepared by the electrical commission for a general extension of the electrical conduit system, to cost about $500,000.

LONACONING, MD.—The plant of the Lonaconing El. Lt. & Pwr. Co. was recently damaged by the bursting of a large flywheel, causing a loss of several thousand dollars.

NEWELL, W. VA.—The Newell Wtr. & Pwr. Co., it is reported, is contemplating increasing the output of its plant, work on which will soon begin. The work will include the erection of a new building and the installation of a low-pressure steam turbine; a triple pump will be installed in the water-works plant. The cost of the work is estimated at $35,000. F. B. Lawrence is general manager.

FRONT ROYAL, VA.—Bids will be received until May 15 for construction of public buildings, including steam heat, electric-lighting and plumbing, on reservation at Remount Depot, Front Royal, Va., as follows: One barrack, administration building and storehouse, one commanding officer's quarters, two junior officers' quarters, one veterinarian's quarters, two double N. C. O. quarters, one dispensary, three colt stables, one wagon shed, one shop building, one veterinary storehouse, subsoil drainage system. A deposit will be required on plans to insure return of same. Further information may be obtained upon application to constructing quartermaster at Front Royal.

RICHMOND, VA.—The management of the Mutual Assurance Society Building, it is reported, contemplates the installation of a storage battery to be operated in conjunction with an isolated plant. Plans are being prepared by A. Lankstaff Johnston, Jr., American National Bank Building, Richmond.

WASHINGTON, D. C.—Bids will be received at the Engineer Depot, United States Army, Washington Barracks, D. C., until May 7, for furnishing two 10-kw, 115-volt direct-current motor-generator sets, together with necessary starting compensators and field rheostats. Further information may be obtained upon application to Lieut. Col. Joseph E. Kuhn.

WASHINGTON, D. C.—Bids will be received at the office of the purchasing agent of the District of Columbia, Washington, D. C., until April 24 for furnishing miscellaneous fuses, branding irons, etc., for the Central High School. Bids will also be received until April 27 for furnishing one voltmeter, two ammeters and one millivoltmeter, 10 battery jars, copper wire, magnet wire, 50 electric carbon lamps, 100 lamp receptacles, four large primary and secondary coils, and four dynamos for the Business High School. For further information address the purchasing agent, District of Columbia.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 5, to furnish at the various navy yards and naval stations supplies as follows: Annapolis, Md., Schedule 6640—one absorption dynamometer. Norfolk, Va., Schedule 6641—one portable, oil-burning, heat-treating furnace. Philadelphia, Pa., Schedule 6642—annual supply of tool, carbon and tungsten steel. Washington, D. C., Schedule 6639—one copper still, seven tanks. Bids will also be received until May 12 as follows: Mare Island, Cal. Schedule 6633—two 20-hp fire-tube vertical boilers; Schedule 6635—air compressor, etc. Puget Sound, Wash., Schedule 6634—four hoists, three 2000-lb. and one 4000-lb. Bids will also be received until May 19 for the following: Mare Island, Cal., Schedule 6638—one motor-driven engine lathe, one motor-driven double emery grinder, one motor-driven upright motor-driven drill press, one motor-driven column shaper; Schedule 6637, —refrigerating plant. Bids will also be received until April 28 for furnishing 10,250 rubber gaskets at Washington, D. C., as per Schedule 6643.

North Central

FLINT, MICH.—An ordinance has been introduced into the City Council compelling all wires to be placed in the business district.

LAPEER, MICH.—The Lapeer Gas-El. Co. expects to install a 150-kva or 200-kva direct-connected unit in the near future. C. W. Smith is manager and C. D. Hulbert, superintendent.

NORTHVILLE, MICH.—It is reported that a large part of the power dam built by the city at a cost of $8,000 has been washed away.

BELLEFONTAINE, OHIO.—Contracts have been awarded by the Board of Control for equipment of the municipal electric-light plant as follows: For steam turbine to the General Electric Co., of Schenectady, N. Y., at $8,000; Babcock & Wilcox Co., of New York, N. Y., for two Stirling 250-hp boilers at $7,200; switchboard to the Fort Wayne El. Works, at $1,745. The clerk of the board of control has been instructed to advertise at once for all auxiliaries necessary for installation of the new plant.

GREENVILLE, OHIO.—The Public Utilities Commission of Ohio has granted the Greenville El. Lt. & Pwr. Co. permission to issue $12,000 in capital stock, the proceeds to be used for the purpose of erecting a transmission line from its plant in Greenville to the works of the Greenville Gravel Co. in Neave Township, a distance of about 7 miles.

MOUNT VERNON, OHIO.—The Ohio Lt. & Pwr. Co., of Mount Vernon, will soon begin work on the erection of a transmission line from Mount Vernon to Frederickstown to furnish electricity in that village. A. J. Darrah is local manager.

PAINESVILLE, OHIO.—The Council has voted to issue $5,000 in bonds for lighting purpose, which will include the installation of an ornamental street-lighting system.

PLAIN CITY, OHIO.—The Board of Public Affairs is contemplating changing the municipal electric-light system from single-phase to three-phase, 60 cycles; also installing a motor-driven centrifugal pump for supplying the village with water. Frank Currier is clerk.

PORT CLINTON, OHIO.—As a result of a tangle over the election held last fall, when the proposal to issue $30,000 in bonds for the installation of a municipal electric-light plant was carried by a small majority, a committee of nine citizens will be appointed to determine what steps are necessary. The Council is ready to advertise the sale of bonds as soon as the matter is settled. The proposition to purchase the distributing system of the Northern Ohio Lt. & Pwr. Co. will not be considered unless a price more satisfactory than the one of $47,000 is given by the company.

WEST UNION, OHIO.—A committee has been appointed to make investigations in regard to the installation of a municipal electric-light plant. S. S. Jones is a member of the committee.

BOWLING GREEN, KY.—The Kentucky Pub. Ser. Co. has submitted a proposal to the City Council offering to furnish electricity to maintain an ornamental street-lighting system and other lamps for $3,714 per year on a moonlight schedule.

HODGENVILLE, KY.—The local electric-light plant, owned by D. E. Patterson, is reported to have been purchased by Dr. O. L. Herron, of Liberty. It is understood that the new owner will enlarge the plant and establish a day service.

HOPKINSVILLE, KY.—The City Council, it is reported, has entered into a con-

tract with the Kentucky Pub. Ser. Co. for the installation of a new street-lighting system, to replace the lamps now in use.

LOUISVILLE, KY.—Investigations are being made by engineers for H. M. Byllesby & Co., of Chicago, Ill., who operate the Louisville Gas & El. Co., of a project to utilize the water-power of the Ohio Falls at Louisville. The plans provide for the use of the old Louisville and Portland Canal, which is not now used, having been replaced by modern canal locks at the falls. It is estimated that sufficient power can be developed to supply electricity for all purposes in Louisville at a cost not to exceed $1,500,000.

HUNTINGTON, IND.—The Public Service Commission has authorized the city of Huntington to enlarge and improve its municipal electric-light plant and to furnish electricity for commercial lighting; also to issue $30,000 in bonds to provide funds for same.

INDIANAPOLIS, IND.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 27, for installation complete of an electric sidewalk type mail lift, etc., in the United States court house and post office at Indianapolis, Ind., in accordance with specifications. For details see proposal columns. O. Wenderoth is supervising architect.

MARTINSVILLE, IND.—The city of Martinsville is planning to install ornamental cluster lamps in the public square, at a cost of about $1,000; it is also proposed to make extensions to the municipal street-lighting system.

NEW ALBANY, IND.—The Louisville & Northern Ry. & Ltg. Co., of New Albany, is reported to be contemplating extending its system between Louisville and Charleston, to Madison; also to extend its transmission line from Charlestown to Sellersburg, for the purpose of furnishing electricity in the latter place, and also to the farmers between the two towns.

BLOOMINGTON, ILL.—The Bloomington & Normal Ry. & Lt. Co., of Bloomington, contemplates erecting a transmission line from Chenoa to Lexington during the coming year. When the line is completed it is proposed to close down the Lexington plant and supply energy from the central station in Bloomington.

CHENEYVILLE, ILL. — Arrangements are being made by J. E. Leach, of Cheneyville, to install an electric-light plant here.

MATTOON, ILL.—The Central Illinois Pub. Ser. Co., of Mattoon, expects to erect within the next 30 days a high-tension transmission line from Camp Point to Clayton. H. M. Brooks is statistician.

SPRINGFIELD, ILL.—Estimates of the cost of the installation of an ornamental street-lighting system on Adams Street from Lewis Street to Tenth Street have been completed by W. D. Seeley, city engineer. The plans provide for 86 ornamental cast-iron standards, 73 carrying five-lamp clusters and 13 three-lamp clusters; 500 ft. No. 4, 4000 ft. No. 6, 4000 ft. No. 8 and 2000 ft. No. 10 three-conductor, 600-volt park cable, and six 4-kw transformers. The cost of the system is estimated at $7,998.

STERLING, ILL.—Preparations are being made for the installation of an ornamental street-lighting system in Sterling, to cost about $9,015. The present plans provide for 82 single-unit steel lamp-posts, equipped with high candle-power tungsten or nitrogen lamps (300 watt), maintained by underground wires; about 9000 ft. of armored cable will be required and constant-current transformers. Contracts will be awarded about May 15. H. S. Green, of Sterling, is engineer, and A. J. Platt is chairman of light committee.

URBANA, ILL.—The lighting committee, it is said, will recommend to the Council the annulling of the present street-lighting contract with the Urbana Lt., Ht. & Pwr. Co. and the execution of a new contract for lighting the streets of the city for a period of ten years. If granted a new contract, the company will remove the present arches and install a cluster-lamp system in the business district. Under the new contract the company will furnish 125 4-amp metallic flame arc lamps.

ASHLAND, WIS.—Bids will be received at the office of the light house inspector, Post Office Building, Detroit, Mich., until April 21 for furnishing steel and iron work and submarine electric cable for light and fog signal station at Ashland, Wis. Blank proposals and further information may be obtained from the above office.

POUND, WIS.—The Coleman-Pound Lt. & Pwr. Co., recently incorporated, will begin work as soon as possible on the erection of a transmission line between the two towns. It is expected that connection will be made with the high-tension lines of the Wisconsin Pub. Ser. Co. from the High Falls plant about Aug. 1. Otto Koenig, of Pound, is interested in the company.

ALBERT LEA, MINN.—Bids will be received by the Board of County Commissioners of Freeborn County, at the office of the county auditor in Albert Lea, until April 28 for furnishing materials and installing heating plant, plumbing system, electric wiring, water and lighting system for the county poor farm building of Freeborn County, situated about 4 miles north of Albert Lea. Plans and specifications are on file in the office of the county auditor. Separate bids must be submitted for each system. C. E. Brainerd is county auditor.

COMFREY, MINN.—The Council has engaged W. S. Buck, of Minneapolis, as consulting engineer in connection with the construction of a municipal electric-light plant, for which bonds to the amount of $8,000 have been voted. Bids will be asked for same as soon as plans are completed, which will probably be ready the latter part of this month. G. W. Schaffer is recorder.

COTTONWOOD, MINN.—The village of Cottonwood has granted a franchise to W. F. Mullaney, of Marshall, Minn., for the installation of an electric-light plant here. W. A. Sisson is village recorder.

MADELIA, MINN.—Steps have been taken by local business men to install an ornamental street-lighting system. C. S. Christiansen is chairman.

ARNOLDS PARK, IA.—A special election will soon be held to submit to the voters the proposal to grant a franchise to A. L. Peck to construct and operate an electric-light plant in Arnolds Park.

CLARINDA, IA.—The Lee El. Co., of Clarinda, has been reorganized under the name of the Lee El. Lt. & Pwr. Co., with a capital stock of $500,000. The company controls franchises in Clarinda, Gravity, New Market, Corning, Blanchard, College Springs, Bradyville and Shambaugh, and will sell electricity to the Bradford Lt. & Pwr. Co.

GOWRIE, IA.—A special election will be held April 24 to submit the proposal to grant the Central Iowa Lt. & Pwr. Co. a franchise to construct and operate an electric-light plant in Gowrie for a period of 20 years.

MANILLA, IA.—At an election held April 3 the proposal to issue $20,000 for the installation of a municipal electric-light plant was carried.

TOLEDO, IA.—Bids will be received by J. H. Ross, secretary of the independent school district of Toledo, until May 4 for the construction of a new building, including installation of heating and ventilating system, and electric wiring. Plans and specifications may be obtained from Proudfoot, Bird & Rawson, architects, of Des Moines.

GRAND FORKS, N. D.—Bids will be received by county auditor, Grand Forks, N. D., until May 7 for furnishing and installing electric fixtures in the Grand Forks county court house, according to plans and specifications now on file in the office of the county auditor, prepared by Buechner & Orth, architects, St. Paul, Minn. Hans Anderson is county auditor.

GRAND FORKS, N. D.—Bids will be received by the board of directors of the Scandinavian American Bank and Northwestern Trust Co., of Grand Forks, until April 29 for the erection of a bank, store and office building at Grand Forks. Separate bids will be received as follows: (a) General work, including the erection of the structural steel; (b) furnishing structural steel; (c) heating; (d) plumbing; (e) electric work. Plans and specifications can be seen at the office of Buechner & Orth, architects, Shubert Building, St. Paul, Minn.; the Builders' Exchange, St. Paul, Minneapolis and Duluth, Minn., and at the office of the Northwestern Trust Co., Grand Forks.

ELK POINT, S. D.—Bids will be received by A. Smythe, city auditor, Elk Point, until April 30 for the construction of an electric-lighting system as follows: (1) brick building for power station; (2) for furnishing and installing equipment, consisting of two 125-hp anthracite gas producers, one 125-hp gas engine and one 75-hp gas engine, directly connected to a 75-kva and a 50-kva alternator respectively, with directly connected exciters, necessary piping and accessories, switchboard, etc.; (3) furnishing and erecting poles, wires, street lamps, transformers, etc., for the electrical distribution system. Plans and specifications are on file in the office of the city auditor, Elk Point, S. D., and at the office of Earle D. Jackson, consulting engineer, Capital Bank Building, St. Paul, Minn.

MITCHELL, S. D.—The city of Mitchell is contemplating the construction of a municipial telephone system, to cost about $60,000.

PARKER, S. D.—At an election held April 3 the proposal to issue $20,000 in bonds for the installation of an electric-light plant was carried. As yet an engineer has not been engaged. C. L. Jones is city auditor.

PRATT, S. D.—At an election held recently the proposal to issue $50,000 in bonds for the installation of a municipal electric-light plant was carried.

MINATARE, NEB.—The installation of a municipal electric-light plant, to cost $6,000, in Minatare, is under consideration.

SUPERIOR, NEB.—The Southern Nebraska Pwr. Co., of Superior, successor to Guthrie & Co., has submitted to the State Railway Commission estimates of a hydroelectric plant to furnish electricity in 20 central Nebraska towns. Electricity is to be generated at a plant on the Republican River, near Superior, and transmission lines erected to Harvard and Sutton, Red Cloud and Fairmont, via Chester. Among the towns to be supplied are Guide Rock, Nelson, Edgar, Fairfield, Clay Center, Harvard, Sutton, Hardy, Byron, Chester, Hebron, Belvidere, Carleton, Strang and Shickley, Geneva and Fairmont. The company has been incorporated with a capital stock of $300,000 and has asked for permission to issue $100,000 in stock and $200,000 in bonds.

LARNED, KAN.—At an election held April 7 the proposal to issue bonds for the installation of an electric-light plant and water-works system was carried. Worley & Black, consulting engineers, Reliance Building, Kansas City, Mo., have charge of the engineering work.

LEAVENWORTH, KAN.—W. J. Squire and O. B. Taylor, both of Kansas City, Mo., the former an electrical engineer, are interested in a project to build a 6000-hp power plant to furnish electricity in Leavenworth and adjacent towns. It is proposed to reopen the Brighton coal mine to provide fuel for the proposed plant, option on which has already been secured. Steps have been taken by the company to secure a franchise to furnish electricity in Leavenworth. The cost of the plant is estimated at $360,000.

Southern States

OLD FORT, N. C.—The White Coal Co., recently incorporated, is planning to build a hydroelectric power plant at Catawba Falls, Old Fort. The equipment will include one 800-hp impulse waterwheel, Lombard oil-pressure waterwheel governors, one 600-kva generator, with switchboard equipment, and transformers. One substation will be erected and 4 miles of copper or aluminum wire will be used. Contracts for construction of plant will be awarded about July 1. Daniel W. Adams, Legal Building, Asheville, N. C., is engineer in charge.

WINSTON-SALEM, N. C.—The Board of Aldermen has called an election, to be held June 23, to submit the proposal to issue $750,000 in bonds of which the proceeds of $250,000 are to be used for the installation of a municipal electric-light and heating plant in the twin cities.

COLUMBIA, S. C.—The City Council is contemplating extending the street-lighting system into North Columbia, as well as into Shandon and Waverly. The Columbia Ry., Gas & El. Co. furnishes the street-lighting service in Columbia.

BLAKELY, GA.—Within the next six months the town of Blakely expects to purchase one boiler-feed pump and a motor-driven fire pump and incandescent series lamps (number not yet decided); also to purchase within the next two months several station-type recording wattmeters, together with current and potential transformers for same. E. R. Adams is superintendent.

MACON, GA.—A movement has been started to form a new company to establish an electric plant to furnish electricity to business houses in the down-town district. Nicholas Christophulos is interested in the project.

MANSFIELD, GA.—At an election to be held April 20 the proposal to issue $5,000 for the installation of an electric-lighting system will be submitted to the voters.

VALDOSTA, GA.—The South Georgia Pwr. Co., recently incorporated with a capital stock of $2,500,000, proposes to construct a hydroelectric plant on Willachoochee River, 4 miles from Valdosta. Electricity generated at the plant will be transmitted throughout the Valdosta district. The incorporators are Frank Roberts, A. S. Pendleton, C. I. Harrell and John T. Roberts, of Valdosta, and B. S. Rucker, of Charlotte, S. C.

FLORA, MISS.—The City Council is contemplating the construction of a municipal electric-light plant, plans for which have been submitted by Massena L. Culley, engineer, of Jackson, Miss.

GREENVILLE, MISS.—The Delta Lt. & Trac. Co., recently incorporated with a capital stock of $200,000, by R. B. Claggett, E. J. Lenz and F. N. Robertshaw, has purchased the property of the Delta El. Lt., Pwr. & Mfg. Co., of Greenville. The new owners, it is understood, will make improvements to the plant.

DANVILLE, ARK.—Within the next two months W. W. Winters, who has leased the Danville electric light plant for a term of five years, expects to install a new plant in a nearby town and to purchase a new turbine outfit complete.

JONESBORO, ARK.—The water and light commissioners expect to erect at once an addition to the power house and to purchase within the next 60 days a new switchboard for the municipal electric-light plant, and within three months a carload of poles. The commission has recently placed orders for a 500-kva generator. J. F. Christy is manager.

GUEYDAN, LA.—The Town Council, it is reported, has awarded contracts for the installation of a municipal electric plant.

LAFAYETTE, LA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 18, for construction, complete (including mechanical equipment, lighting equipment and approaches) of the United States post office at Lafayette. Drawings and specifications may be obtained from the above office or from the custodian of site at Lafayette. O. Wenderoth is supervising architect.

CARLSBAD, TEX.—Among the improvements contemplated by the commissioners for the Texas Tuberculosis Sanitarium at Carlsbad is the installation of an electric-light system, at a cost of about $9,000; this would include boilers which could be used for heating purposes.

DALLAS, TEX.—Estimates are now being received by the Continental Gin Co. for electrical work in connection with extensions and improvements now being made to its property. The equipment will include three 200-hp Frost return tubular boilers, one 330-hp Harrisburg engine, directly connected to a 250-kw Westinghouse, two-phase, 60-cycle, 220-volt, 200-r.p.m. generator, switchboard complete, 75-hp compressor, feed pumps, feed-water heater and injector, etc. The electric-light and power mains will be underground and will be of the usual lead-cable type; the remainder of the wiring of the plant will be of the rigid conduit type. The cost of the electrical work is estimated at $20,000. All equipment except motors and generators will be contracted for. M. G. Farrell, of the Suffern Engineering Corpn., is chief engineer.

DAYTON, TEX.—The installation of an electric-light plant is under consideration. J. B. Sterling and associates are reported to be interested.

FRANKLIN, TEX.—Bonds to the amount of $17,500 have been voted for the installation of a municipal electric-light plant and water-works system to replace the plants recently destroyed by fire.

HOUSTON, TEX.—Plans are being considered by J. M. Barnes to install an electric-light plant at Magnolia Park.

SAN ANTONIO, TEX.—It is reported that sufficient funds have been raised to pay for the maintenance of the new lighting system on Houston Street. The San Antonio Gas & El. Co. has agreed to install the ornamental lighting system provided the city and merchants will pay to maintain same.

TERRELL, TEX.—The Terrell El. Lt. Co. has rebuilt its plant and is now furnishing electrical service. The plant was destroyed by fire on March 20, and four days later the company was giving temporary service to most of its patrons. Fourteen days after the fire the plant was running. M. A. Joy is president.

Pacific States

BUCKLEY, WASH.—The property of the Buckley Electrical Co. has been purchased by the Puget Sound Trac., Lt. & Pwr. Co., of Seattle. The new owners will erect a transmission line from the power station in Deringer to Buckley in the near future.

COLVILLE, WASH.—The Stevens County Lt. & Pwr. Co. is negotiating with the City Council for lighting the streets of the city. If granted a contract, the company will make several extensions and improvements to its system this spring.

ANDREWS, ORE.—Plans have been completed and surveys made for the construction of a hydroelectric power plant on Wild Horse Creek during the summer and fall. Electricity generated at the plant (three phase, 60 cycles, 220 volts) will be used for operating pumps for irrigating purposes and for lamps and motors. Contracts have already been secured for the entire output of the initial installation. Jean Bart Balcomb, of Andrews, as executive engineer, will have charge of construction and operation of the plant.

FALLS CITY, ORE.—Within the next six months the Falls City El. Lt. & Pwr. Co. expects to purchase a generator, transformers, also arc and incandescent lamps. H. C. Brown is vice-president and manager.

PORTLAND, ORE.—The City Commission has authorized Municipal Purchasing Agent Wood to advertise for bids (date of closing not announced) for the installation of an electric-light system along the Terwilliger Boulevard, from Hamilton Avenue northward to Sheridan Street.

BAKERSVILLE, CAL.—The Kern County Highway Commission is planning to install a rock-crushing plant at Keene, near Woodford, on the Southern Pacific Railroad. Bids and competitive designs are requested for the complete equipment of an electrically operated plant, which shall have an output of 1000 tons in eight hours. The equipment to include one primary and two secondary crushers with motors, screens, conveyors, bins, air compressor, tripod and hammer drills, together with all necessary apparatus for a first-class plant. Each crusher is to be driven by a medium or low-speed motor with three adjustable dust-proof bearings. All electrical apparatus to be protected by overload relay coils. There shall be no fusible safety devices used. The county will furnish energy at the quarry site, at 440 volts, three-phase, 50 cycles. It is expected that bids will be opened the second week in May. Contour maps of quarry site and specifications for plant may be obtained at the office of the commission, County Court House, Bakersfield. P. H. Everett is chief engineer.

DOWNEY, CAL.—The Southern California Edison Co. and the Downey Lt., Pwr. & Wtr. Co. have joined in an application to the State Railroad Commission for authority to transfer the Downey company to the Southern California company for $50,938. The latter company has furnished electricity to the Downey company.

DURHAM, CAL.—Within the next three months the Durham Lt. & Pwr. Co. expects to purchase electrical appliances, including cooking apparatus, household devices, washing machines, etc.

ELSNORE, CAL.—The Southern Sierras Pwr. Co. is installing a new substation in Elsinore. E. E. Robinson is local superintendent.

KINGSBURG, CAL.—The city trustees have adopted a resolution authorizing the installation of 30 electroliers carrying five-lamp clusters on Draper Street, to cost about $3,000.

OXNARD, CAL.—H. E. Huntington, president of the Los Angeles Ry. Corpn., has purchased the controlling interest of the Ventura County Pwr. Co., of Oxnard, and will begin at once the development of a large distributing system in Ventura County.

SACRAMENTO, CAL.—Bonds to the amount of $113,000 will be sold at once, the proceeds to be used for the installation of street lamps.

ST. HELENA, CAL.—The State Railroad Commission has granted the Napa Valley El. Co., of St. Helena, permission to serve consumers in Napa Valley, from Bale Station to the northernly limits of Napa County, except in the town of Calistoga.

TERRA BELLA, CAL.—The Mount Whitney Pwr. & El. Co., of Visalia, is planning to build a substation about 1 mile east of Terra Bella, work on which will soon begin.

FILLMORE, UTAH.—A proposal has been submitted to the City Council by Messrs. Yates and Richards, of Salt Lake City, for installing an electric-light plant to light the city, at a cost of about $17,500. They have filed on water rights in the canyon near Fillmore.

LEHI, UTAH.—Application has been made to the City Council by C. W. Earl to erect an electric-light plant in Lehi.

MESA, ARIZ.—Within the next three months the South Side Gas & El. Co. expects to install frequency station equipment to increase the output of its plant by 250 kw. H. L. Chandler is manager.

HARDIN, MONT.—The Big Horn Canyon Irrigation & Pwr. Co. has completed surveys for an electric railway, 68 miles long, and is now surveying for the dam site and reservoir. When this is completed the survey for the irrigation system will be started. The project includes the construction of a hydroelectric plant on the Big Horn River to develop 25,000 hp at a minmum flow; construction of an electric railway, 68 miles long, penetrating a very fertile valley; irrigation by gravity of 100,000 acres and by electricity generated at the dam of 35,000 acres. The railroad will be constructed first and used to transport building material to the dam site. Edward Lawlor is secretary.

HELENA, MONT.—Bids will be received at the office of the city clerk, Helena, Mont., until May 4 for the installation of an ornamental street-lighting system, consisting of 391 lamp-posts, on the west side of the city. Plans and specifications are on file in the office of William Jordan, Jr., city engineer, 14 Kohrs Blocks, Helena. For details see proposals columns. D. J. McConnell is city clerk.

LAUREL, MONT.—The Council is reported to be considering the installation of a street-lighting system in Laurel.

MAXVILLE, MONT.—The operating plant of the Royal Basin Mining Co. in Maxville is to be equipped with electrically operated machinery. Energy will be supplied by the Montana Pwr. Co. The new concentrator is among the units to be run by electricity. Surveys have been made for the transmission line, and construction work will begin as soon as possible.

LANDER, WYO.—A hydroelectric plant, to cost about $200,000, it is reported, is being erected on the Popo River, about 10 miles from Lander. The plant when completed will furnish electricity in Lander and adjacent country.

DENVER, COL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 23, for mechanical equipment for the United States post office building in Denver, Col. Further information may be obtained from the above office. O. Wenderoth is supervising architect.

Canada

FORT SASKATCHEWAN, ALTA. — Within the next five months the managers of the municipal electric-light plant expect to install a new street-lighting system and to purchase a large transformer. E. G. Ferguson is electrician and chief engineer.

WINNIPEG, MAN.—Tenders will be received by the City Light and Power Department of the city of Winnipeg until April 30 for furnishing and erecting two three-phase synchronous condensers. Plans and specifications may be obtained from the city Light and Power Department.

BRANTFORD, ONT.—Tenders will be received by F. W. Frank, secretary and treasurer of board of water commissioners, until April 30, as follows: (B) For fireproof pump house; (G) pumping machinery (a) two 4,000,000-gal. turbine pumps and two motors to operate same; (b) two 4,000,000-gal. motor-driven booster pumps for fire service; (c) steam turbine alternative for operating booster pumps. Bidders may submit bulk offers for "B" and "G." Plans and specifications may be seen at the City Hall, Brantford, or at the office of Chipman & Power, engineers, 204 Mail Building, Toronto.

MOUNT FOREST, ONT.—The Town Council, it is reported, will make an application to the Hydro-Electric Power Commission of Ontario for 500 hp hydroelectric power, to be supplied from Eugenia Falls.

WINDSOR, ONT.—The Sandwich, Windsor & Amherstburg Ry. Co., controlled by the Detroit United Ry. Co., of Detroit, Mich., has refused the offer of $155,000 by the Ontario Hydro-Electric Commission for its power plant in Windsor. The plan of the commission was to purchase the plant of the railway of the company and use it in connection with Niagara power. It probably now will erect a system of its own here.

REGINA, SASK.—Tenders will be received by the city commissioners, Regina, Sask., until April 27, for material for street railway system as follows: (A) 100 tons 7-in. steel T-rails (Lorain section 80/335), 1000 track bolts and nuts (¾ in. by 3¾ in.), 1200 copper rail bonds (10⅛ in.), 60 copper rail bonds (42 in.), 60 copper rail bonds (72 in.); (B) 9000 barrels Canada Portland cement; (C) 3 miles 500,000 circ. mil. triple-braid, weatherproof, 19-strand feeder wire, 2 miles 0000 triple-braid weatherproof, 19-strand feeder wire, 10,000 ft. 00 hard-drawn, round trolley wire; (D) trolley frogs, crossovers, line cars, insulators, hangers and pole line hardware. All material to be delivered f.o.b. Regina, and duty paid. Copies of specifications, form of tender, etc., may be obtained upon application to H. Doughty, superintendent, Regina municipal railway.

DAWSON, Y. T.—The Civic League has undertaken to raise $200,000 for the purpose of establishing a municipal electric-light plant, telephone and water-works systems in Dawson. The cost of the work is estimated at $165,000.

Miscellaneous

CORDOVA, ALASKA.—James J. Godfrey, president of the Mother Lodes Mines Co., has announced that extensive development plans are under way, including the installation of a large power plant.

New Incorporations

PORTLAND, MAINE—The Carrabassett Lt. & Pwr. Co. has been incorporated with a capital stock of $50,000. The company proposes to develop water-powers and construct power plants to furnish gas and electricity in the towns of Anson, Embden and New Portland. The officers are: George H. Hinckley, president; J. Frank Conner, treasurer, and Benjamin G. Ward, clerk, all of Portland.

SENATH, MO.—The Senath Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 by Alvin Chapman, W. W. Watson and J. L. Davis.

WEST LIBERTY, OHIO.—The West Liberty Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 for the purpose of supplying electricity for commercial purposes. It is understood that the company will secure electricity from the Ohio El. Ry. Co. The incorporators are M. J. Kehoe, H. S. Gilham, Morgan Doolan, P. C. Martin and J. F. Shafer.

ELLOREE, S. C.—The Elloree El. Lt. Co. has been incorporated with a capital stock of $5,000 by E. F. Irich, J. F. Ulmer, S. D. Montgomery and others.

ALPINE, TEX.—The Alpine Lt. & Ice Co. has been chartered with a capital stock of $20,000. The incorporators are J. D. Jackson, S. D. Harman and George C. Miller.

SCOTTSVILLE, TEX.—The Scottsville El. Lt. Co. has been incorporated with a capital stock of $5,000 by J. D. Read, J. B. Dodson and H. L. Hendrick.

WILSON CREEK, WASH.—The Grant County Pwr. Co. has been incorporated with a capital stock of $40,000 by D. O. Friel, S. W. Roberts and Barton Morgan.

WINDSOR, ONT., CAN.—The Windsor Pwr. Building Co. has been incorporated with a capital stock of $100,000 by R. J. Fox, C. H. Collins and F. Rogers.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 7, 1914.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,092,141. Electropneumatic Brake Apparatus; E. H. Dewson, New York, N. Y., and W. V. Turner, Edgewood, Pa. App. filed May 9, 1910. Means operated both electrically and pneumatically for locally venting air from the train pipe.

1,092,153. Cartridge Fuse; E. B. Mallory, Chicago, Ill. App. filed Sept. 9, 1912. Refillable fuse with special means for aligning the contact blades.

1,092,245. Electric Switch; G. W. Cravens, Chicago, Ill. App. filed July 30, 1910. Pullman-car upper-berth switch.

1,092,252. Method of Constructing Secondary of Storage Batteries; G. L. and G. J. A. Fuller, Bow, London, Eng. App. filed Nov. 15, 1912. Electrodes in block form fitted together.

1,092,253. Secondary or Storage Battery; G. L. and G. J. A. Fuller, Bow, London, Eng. App. filed Sept. 4, 1913. Electrodes in block form or taper form in cross-section.

1,092,266. Electric Signal Mechanism; W. R. Howe, Rochester, N. Y. App. filed Dec. 3, 1909. Electric semaphore motor operates as a brake during return of semaphore to danger position.

1,092,267. Process of Making Storage-Battery Electrodes; H. C. Hubbell, Newark, N. J. App. filed July 17, 1911. Briquettes and reduces a nickel oxide.

1,092,281. Combined Motor Starter and Circuit-Breaker; A. C. McWilliams, Chicago, Ill. App. filed June 19, 1912. Automatic starter for direct-current motors.

1,092,283. Relay; M. S. Morse, Oakland, Cal. App. filed Aug. 22, 1912. For controlling signals at railway crossings.

1,092,295. Process and Apparatus for Absorbing Nitrous Vapors in the Dry and with Heat by the Aid of a Base Such as Lime; A. T. Schloesing, Paris, France. App. filed May 25, 1912. Employs no external heat.

1,092,323. Electric Recorder; J. L. Zander, Irvington, N. J. App. filed Nov. 7, 1912. Records the measure in voltage or temperature in connection with a plurality of thermocouples.

1,092,333. Refillable Fuse; F. D. Bryan, Middletown, Pa. App. filed Aug. 27, 1913. End disks clamp ends of fuse strips in place.

1,092,354. Fortune-Telling Apparatus; W. M. Hamilton, Philadelphia, Pa. App. filed July 22, 1913. Controllable magnet moves a cylinder up an inclined path having fortune-telling designations.

1,092,369. Process of Making Chlorates and Apparatus Therefor; G. Kolsky, Niagara Falls, N. Y. App. filed April 4, 1913. Electrolysis of saline solutions.

1,092,370. Electric Ignition Generator; B. Lawrence, Leyton, England. App. filed June 3, 1913. Starting trip accelerates generator movement when cranking engine.

1,092,383. Safety and Signaling Device for Railroads; D. C. Newton, Owego, N. Y. App. filed Oct. 23, 1913. Ramp rails at ends of blocks.

1,092,388. Water-Level Indicator; N. Podgoursky, St. Petersburg, Russia. App. filed March 30, 1912. For indicating presence or absence of water in the compartments of a ship.

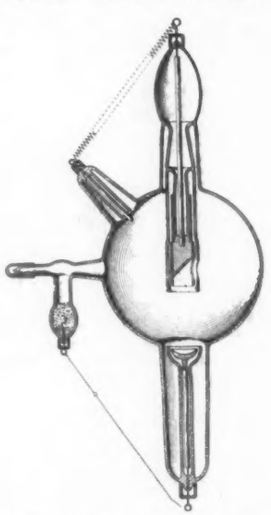
1,092,398. High-Tension Discharge Apparatus; G. D. Rodgers, Cleveland, Ohio. App. filed May 31, 1913. For producing discharges for therapeutical purposes from ordinary lamp socket.

1,092,401. Sheet-Music-Perforating Device; A. D. Saumell, New York, N. Y. App. filed Feb. 15, 1912. Operated by usual piano keyboard or a dummy keyboard.

1,092,410. Means for Rating Incandescent Lamps; A. J. Sweet, Newark, Ohio. App. filed May 16, 1910. Rating in terms of the watts per candle-power and the corresponding voltage for any particular lamp obtained expeditiously with one set of instrument readings.

1,092,411. Electric Railway and Signaling System Therefor; L. H. Thullen, Edgewood, Pa. App. filed March 3, 1906. Protects the inductive bonds and other apparatus from dangerous unbalancing of the resistance in the track rails to the flow of propulsion current therealong.

1,092,415. Automatic Service Switch; R. E. Wetter, Dallas, Tex. App. filed Aug. 3, 1912. Circuit including interior wiring of a building automatically broken when voltage increases to dangerous degree.



1,092,489—X-Ray Tube

1,092,417. Ignition Apparatus; J. A. Williams, Cleveland, Ohio. App. filed March 5, 1913. Improved vibrator construction designed to prevent tampering and maladjustment of the same.

1,092,420. Dynamo-Electric Machine; E. F. W. Alexanderson, Schenectady, N. Y. App. filed June 19, 1913. High-frequency alternating-current machine with mechanically rigid field member.

1,092,430. Fuse Clip; R. C. Cole, Hartford, Conn. App. filed March 17, 1913. High-current-capacity clip for knife-blade fuses.

1,092,453. Device for Amplifying Variations in Electrical Currents; P. M. Rainey, West Hoboken, N. J. App. filed Oct. 14, 1913. Telephone relay or repeater.

1,092,459. Railway Signaling; J. B. Struble, New York, N. Y. App. filed Nov. 16, 1901. Alternating current in track circuits and direct current in propulsion circuit.

1,092,460. Railway Signaling; J. B. Struble, San Francisco, Cal. App. filed March 4, 1904. Direct-current propulsion and alternating-current signaling circuits, with one rail electrically continuous and the other rail divided into insulated block sections.

1,092,466. Locomotive Fireman's Coal-Shoveling Recorder; G. G. Weston, St. Louis, Mo. App. filed April 11, 1913. Records number of times fire door is opened and length of time it is kept open during a trip.

1,092,472. Connecting Clip for Electrical Conductors; J. H. Breaznell, New York, N. Y. App. filed Sept. 21, 1912. Has pair of pivoted hook-shaped clip members of spring material.

1,092,489. X-Ray Tube; H. M. Kesselring, Chicago, Ill. App. filed Oct. 17, 1912. To prevent the puncturing of the tube at points adjacent to the electrodes.

1,092,498. Refillable Cartridge Fuse; E. B. Mallory, Wilkinsburg, Pa. App. filed Oct. 3, 1911. Fuse strip clamped at ends so as to expose its capacity marking and manufacturer's trade-mark.

1,092,510. Lightning Arrester; A. Allendorf, Harvard, Ill. App. filed Oct. 9, 1912. For protecting telephone lines; has automatically replaced fuses.

1,092,513. Electrical Window Alarm Lock; M. Barros, New York, N. Y. App. filed April 28, 1913. Closes alarm circuit when window is raised and holds window locked against further upward movement.

1,092,526. Moisture-Removing Device; W. G. Hassel and R. W. Zedlitz, Waterbury, Conn. App. filed May 16, 1913. Slotted tubular heater surrounds wind shield or window pane for evaporating moisture thereon.

1,092,589. Connector; L. C. Nichols, Milwaukee, Wis. App. filed Nov. 20, 1909. Interfitting screw members held together by a nut engaged on the interfitting screw portions of said members.

1,092,600. Primary Battery; C. B. Schoenmehl, Waterbury, Conn. App. filed Dec. 9, 1910. Special means for suspending the assembled positive and negative electrodes.

1,092,627. Locking Device for Electric Lamps, etc.; A. D. Bartlett, Washington, D. C. App. filed June 9, 1913. Has an electromagnetically operated locking bolt.

1,092,724. Motor Starter for Rectifier Systems; M. Kushlan, Boston, Mass. App. filed Dec. 21, 1911. As resistance is cut out of the motor circuit resistance is cut into the storage-battery circuit.

1,092,732. Signal Device; J. H. McCartny, Stafford Springs, Conn. App. filed Jan. 20, 1913. Notifies wireless operator when message is coming in, thus eliminating need for continuously wearing the receivers.

1,092,754. Thermostatic Circuit Closer; R. L. Shannon, Ripley, Miss. App. filed June 7, 1913. Relatively stationary contact carried by an adjustable pointer.

1,092,797. Electric-Speed-Controlling Means; H. A. Mayor, Glasgow, Scotland. App. filed Sept. 20, 1909. For body having an induction motor drive.

1,092,805. Electric Safety Fuse; E. Weissberg, Cassel, Germany. App. filed June 4, 1913. Has closed oil chamber in which melting spark is extinguished.

DETAILS OF TRANSMISSION SYSTE

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
				RATING OF PLANT, KW			TURBINES						GENERATORS					STEP-UP		
	Name	Operating Voltage	Frequency Cycles	Present	Ultimate	Beginning of Operation	Hydr. or Steam	H.P.	Head Ft.	R.P.M.	Shaft Hor. or Vert.	Manufacturer	Kva.	Kw.	P.F.	Voltage	Manufacturer	Kva.	Phases	Co L.T.
1	Pacific Light & Power Co	150,000	50	59,500	300,000	1913	H.	2x10,000	1780 1900	375	H.	Al. Ch.	17,500	14,875	.85	6,600	W. G.E.	5,833	1	Δ
2	Au Sable Elec. Co	140,000	60	19,000	86,500	1912	H.	3,500 4,150	26 35 40	120 164 180	H.	Al. Ch.	2,200 3,333 3,333	2,000 3,000 3,000	.90	2,500	G.E.	3,000	1	Δ
3	Southern Sierras Power Co	140,000	60	8,750	40,000	1915	H.	3,300	814 and 258	300 164	H.	Henry Pelton Doble	2,250 2,000	2,250 2,000	1.	2,200	C.W. Al. Ch.	750 2,000	1	Δ
4	Utah Power & Light Co	1 0,00	60	33,000	84,000	1914	H.	16,500 15,000	482 140	514 180	V.	I. P. Morris	12,222 11,111	11,000 10,000	.90	6,600	W. G.E.	4,000	1	Δ
5	Pacific Gas & Electric Co	125,000 to 110,000	60	25,000	142,500	1913	H.	2x8,500	1375	360	H.	Pelton Doble	12,500	10,000	.80	6,600	W.	4,250	1	Δ
6	West Penn. Trac. & Water Power Co	125,000	60	32,000	105,000	1914	H.	12,000	82	144	V.	W.S.M.	10,000	8,000	.80	6,600	Al. Ch.	10,000	3	Δ
7	Tennessee Power Co	120,000	60	15,000	75,000	1914	H.	10,000	250	360	H.	I. P. Morris	9,375	7,500	.80	6,600	W. G.E.	9,375	3	Δ
8	Connecticut River Transmission Co	120,000	60	14,400	14,400	Ca. 1914	H.	Ca. 3,300	57 to 64	257	H.	W.S.M.	2,000	1,600	.80	2,300	G.E.	3,000	3	Δ
9	Inawashiro Hydroelectric Power Co	115,000	50	42,000	73,500	1914	H.	Ca. 10,000	350	375	H.	Voith	7,700	7,000	.91	6,600	Dick Kerr	4,400	1	Δ
10	Au Sable Electric Co	110,000	30	9,000	45,000	1906	H.	14,400	40	225	H.	Leffel	3,000	3,000	1.	6,600	W.	3,750	1	Δ
11	Hydro-Electric Power Commission of Ontario	110,000	25	106,800	175,000	1910	H.	12,500 12,500 13,400	175	187½	H.	Voith W.S.M.	7,500 8,950 9,700	7,500 8,950 9,700	1.	12,000	W. G.E.	3,500	1	Δ
12	Lauchhammer, A. G	110,000	50	15,000	20,000	1911	S.	.....	....	1000	H.	A.E.G. M.A.N.	14,300 6,250	10,000 5,000	.70 .80	5,000 5,000	A.E.G. S.-S.	6,250	3	Y
13	Georgia Ry. & Power Co	110,000	60	50,000	63,000	1912	H.	17,000	580	514	V.	S.M. Smith	12,500	10,000	.80	6,600	G.E.	3,333	1	Δ
14	Alabama Power Co	110,000	60	48,000	300,000	1913	S.	17,500	68	100	V.	I.P. Morris	14,000	12,000	.85	6,600	W.	4,667	1	Δ
15	Mississippi River Power Co	110,000	25	112,500	225,000	1913	H.	10,000	32	57.7	V.	I.P. Morris W.S.M.	9,000	....	.....	11,000	G.E.	9,000	3	Δ
16	Lehigh Navigation Electric Co	110,000	25	30,000	100,000	1914	S.	.....	....	1500	H.	G.E.	12,500	11,250	.90	11,000	G.E.	3,350	1	Δ
17	Cedar Rapids Mfg. & Power Co	110,000	60	90,000	135,000	1914	H.	10,800	30	55.4	V.	I.P. Morris W.S.M.	10,000	7,500	.75	6,600	G.E.	4,000 8,000	1	Δ
18	Mexican Northern Power Co	110,000	60	26,000	.....	1914	H.	10,000	230	360	H.	Esch. W.	7,800	7,630	.85	4,000	G.E.	2,500	1	Δ
19	Ebro Irrigation & Power Co. Ltd	110,000	50	50,000	200,000	1914	H.	14,500	164	250	V.	Esch. W.	16,666	10,000	.60	6,600	G.E.	4,444	1	Δ
20	Chile Exploration Co	110,000	50	40,000	160,000	1915	S.	.....	....	1500	H.	Esch. W.	10,000	10,000	1.	5,000	S.-S.	10,000	3	Y
21	Sierra Elec. Power Co	110,000	..	.....	22,500	....	H.	.....	....	....	..	.....	.....	.....	.....	.....	.....	.....	...	....
22	Sierra & San Francisco Power Co	104,000	60	34,000	.....	1910	H.	11,750	1500	400	H.	Pelton	8,500	8,500	1.	4,000	G.E.	2,233	1	Δ
23	Great Falls Power Co	102,000	60	21,000	125,000	1910	H.	6,000	105	225	H.	S.M. Smith	3,500	3,500	1.	6,600	G.E.	1,200	1	Δ
24	Yadkin River Power Co	100,000	60	24,000	.....	1912	H.	5,900 5,200	45	164	H.	S.M. Smith	6,000 4,500	4,500 3,500	.75 .78	4,000	G.E.	6,250	3	Δ
25	Colorado Power Co	100,000	60	10,000	10,000	1909	H.	9,000	170	400	H.	I.P. Morris	5,000	5,000	1.	4,000	G.E.	3,333	1	Δ
26	Great Western Power Co	100,000	60	50,000	100,000	1909	H.	18,500 18,000	450 525	400	V.	I.P. Morris	12,500 10,000	10,000 10,000	.80 1.	11,500 11,000	G.E	10,000	3	Δ
27	Southern Power Co	100,000	60	75,000	.....	1909	H.	5,200	69	225	H.	Holyoke Mach. Al.Ch.	3,000	2,550	.85	2,400	W.	4,000	1	Δ
28	Shawinigan Water & Power Co	100,000	60	45,000	80,000	1911	H.	18,500	145	225	H.	I.P. Morris	15,000	12,500	.86	6,600	W.	14,000	3	Δ
29	Los Angeles Aqueduct	100,000	50	22,500	138,000	1914	H.	14,000	870	200	H.	Doble	9,375	7,500	.80	6,600	W.	3,150	1	Δ
30	Tata Hydroelectric Co	100,000	50	40,000	64,000	1914	H.	11,000	1661 to 1727	300	H.	Esch. W.	10,000	8,000	.80	5,000	S.-S.	3,333	1	Δ
31	Pfalzwerke, A. G	100,000	50	10,000	50,000	1915	S.	.....	....	....	..	.....	.....	.....	.....	.....	.....	.....	...	....
32	Societa Italiana di Elettrochimica	88,000	42	23,280	29,100	1912	H.	8,200	249	420	H.	Riva	7,300	5,820	.80	6,600	Brown Boveri	3,600	1	Δ
33	Appalachian Power Co	88,000	60	20,610	75,000	1912	H.	6,000 3,500	51 37	116 97	V.	I.P. Morris	4,000 2,300	3,600 2,070	.90	13,200	G.E.	6,000	3	Δ
34	Rio Janeiro Tramway, Light & Power Co	88,000	50	48,800	90,000	1913	H.	19,000 8,700	1017	300	V.	Esch. W.	12,500 6,000	10,000 4,800	.80	6,300	W.	4,167 1,700	1	Δ
35	Sao Paulo Electric Co	88,000	60	30,000	50,000	1914	H.	14,500	600	600	H.	Voith	12,500	10,000	.80	6,300	W.	3,333	1	Δ
36	Tasmania Hydroelectric & Metal Co	88,000	50	.....	50,000	....	H.	.....	....	....	..	.....	1,350	1,700	.....	.....	W.	.....	1	Δ
								7,000	1200											

TEMS OF THE WORLD OPERATING AT AND ABOVE 70,000 V

Compiled for the ELECTRICAL WORLD by Selby Haar

19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
EP-UP TRANSFORMERS						**STEP-DOWN TRANSFORMERS**				**TRANSMISSION LINES**												
Phases	Conn.		Y Gr. Dir. or with Res.	Total Kva. Connected to Transmission Lines	Manufacturer	Line Voltage		Conn.		Termini	Dist. of Trans., Mi.	Steel Towers or Wood Poles	Height, Ft.	Span		Circuits		Conductors				
	L. T.	H. T.				L.T.	H.T.	L. T.	H. T.					Normal Ft.	Max. Ft.	Per Tow'r	Total	Section-Gage and Sq. In.	Material	Strands	Core	
1	Δ	Y	D.	70,000	W. G.E.	72,000 18,000	150,000	Δ	Δ	Big Creek–Los Angeles, Cal.	241	S.T.	Ca. 48–	660	2900	1	2	605,000 Circ. M. 0.475. 78,000 Circ. M. 0.061	Al.	54 7	St.	
1	Δ	Δ	No	19,000	G.E.	5,000 22,000 44,000	140,000	Δ	Δ	Au Sable–Battle Creek, Mich.	245	S.T.	40–167	500	600?	1	1	O. B. & S. 0.083	Cu.	7	Cu.	
1	Δ	Y	R.	8,250	W.	33,000 to 4,000	138,500 140,000	Δ	Y	Bishop–San Bernardino, Cal.	239	S.T.	70–	660	1500	2	2	211,160 Circ. M. 0.166. 34,970 Circ. M. 0.027	Al.	6 1	St.	
1	Δ	Δ	No	24,000	G.E.	44,000	120,000	Δ	Δ	Grace, Idaho–Salt Lake City, Utah.	135	S.T.	82–	650	2200	2	2	250,000 Circ. M. 0.196	Cu.	12	Cu.	
1	Δ	Y	D.	25,500	Al. Ch.	60,000	100,000	Y	Y	Drum–Cordelia, Cal.	110	S.T.	82–50–	800	2350	1 and 2	1	00000 B. & S. 0.210	Cu. Al.	7 19	Cu. Al.	
3	Δ	Δ	No	40,000	Al. Ch.	22,000 6,600	120,000	Δ	Δ	Cheat Haven–Butler, Pa.	106	S.T.	44– 80	528	.....	2	2	O. B. & S. 0.083	Cu.	6	Cu.	
3	Δ	Δ	No	18,750	W. G.E.	13,200	120,000 to 95,000	Δ	Δ	Cleveland–Nashville, Tenn.	140	S.T.	50–210	663	1903	1 and 2	2	00 B. & S. 0.105	Cu.	7	Cu.	
3	Δ	Y	D.	18,000	G.E.	13,200	110,000	Δ	Δ & Y	Shelburne Falls–Millbury, Mass.	60	S.T.	75–	600	1200	2	2	00 B. & S. 0.105	Cu.	7	Cu.	
1	Δ	Δ	No	52,800	W.	11,000	100,000	Δ	Δ	Lake Inawashiro–Tokio, Japan.	144	S.T.	70–220	550	1530	2	4	100 Sq. Mm. 0.155	Cu.	7	Cu.	
1	Δ	Δ	No	11,250	W.	19,000 7,200	.....	Δ	Δ	Croton–Grand Rapids and Muskegon, Mich.	35	S.T.	53– 60	528	.....	1	2	2 B. & S. 0.052	Cu.	6	Hemp	
1	Δ	Y	R.	42,000	W.	26,400 13,200 6,600	110,000	Δ	Y	Niagara Falls–Toronto and St. Thomas, Canada.	135 90	S.T.	61.3–170	550	1100	2	2	0000 B. & S. 0.166 000 B. & S. 0.132	Cu. Al.	7	St. Cu. Al.	
3	Y	Y	No	20,000	S.-S.	60,000 15,000	110,000	Y	Y	Lauchhammer Mines–Riesa, Germany.	35	S.P.	60– 65	550	900	2	2	42 Sq. Mm. 0.066	Cu.	7	Cu.	
1	Δ	Y	R.	60,000	G.E.	22,000 11,000	110,000	Δ	Δ	Tallulah Falls–Lindale, Atlanta, Ga., etc.	210	S.T.	66–105	550	1200	2	2	0000 B. & S. 0.166 00 B. & S. 0.105	Cu.	7	Cu.	
1	Δ	Y	R.	56,000	W.	22,000	110,000	Δ	Δ & Y	Coosa River–Birmingham, etc., Ala.	150	S.T.	65– 68	600–700	900–1200	2	2	00 B. & S. 0.105	Cu.	7	Cu.	
3	Δ	Y	D.	72,000	G.E.	66,000 33,000 13,200	95,000	Δ	Δ	Keokuk, Ia.–St. Louis, Mo.	144	S.T.	79–231	800	3300	2	2	300,000 Circ. M. 0.235	Cu.	19	Cu.	
1	Δ	Y	R.	30,150	G.E.	22,000	110,000	Δ	Δ	Hauto–Siegfried, Pa.	24	S.T.	78.5	600	2000	2	2	250,000 Circ. M. 0.196	Cu.	7	Cu.	
1	Δ	Δ	No	72,000	.....	6,600	110,000	Δ	Δ	Cedar Rapids, Can.–Massena, N. Y.	60	S.T.	70	660	.....	2	2	500,000 Circ. M.	Al.	....	St.	
1	Δ	Y	R.	22,500	G.E.	13,200	110,000	Δ	Y	Boquila–Parral, Chihuahua, Mexico.	157	S.T.	65– 90	575	1100	2	2	Equi. Cu. 0000 B. & S. 0.166	Al.	7	Al.	
1	Δ	Δ	No	66,666	W.	25,000 6,000	100,000	Y	Δ	Segre River–Barcelona, Spain.	105	S.T.	65–	750	1500	2	4	0000 B. & S. 0.166	Cu.	7	Cu.	
3	Y	Y	No	40,000	S.-S.	5,000	Ca. 100,000	Y	Y	Tocopilla–Chuquicamata, Chile	86	S.T.	47–	656	.....	1	1	000 B. & S. 0.132	Cu.	7	Cu.	
....	....	....	....	.....	.....	.....	.....	....	....	Mill Creek–Oakland, Cal.	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	
1	Δ	Y	D.	26,800	G.E.	11,000	104,000	Δ	Y	Stanislaus–San Francisco, Cal.	138	S.T.	65–	850	1600	2 and 1	2	00 B. & S. 0.105	Cu.	6	Hemp	
1	Δ	Δ	No	21,600	G.E.	2,500	91,800	Δ	Δ	Great Falls–Butte, and Anaconda, Mont.	150	S.T.	45–	600	3034	1	2	0 B. & S. 0.083	Cu.	6	Hemp	
3	Δ	Y	D.	37,500	G.E.	60,000	100,000	Δ	Δ	Blewitts Falls–Raleigh and Lumberton, N. C.	96	S.T.	72.6–	650	1455	2	2	0 B. & S. 0.083	Cu.	6	None	
1	Δ	Δ	No	15,000	G.E.	6,600	90,000	Δ	Δ	Glenwood–Denver, Colo.	152	S.T.	44.2–	660	2900	1	1	0 B. & S. 0.083	Cu.	6	Hemp	
3	Δ	Δ	No	50,000	G.E.	11,000	90,000	Δ	Δ	Big Bend–Oakland, Cal.	154	S.T.	75–210	750	2740	2	2	000 B. & S. 0.132	Cu.	7	.....	
1	Δ	Y	R.	24,000	W.	44,000 13,000 2,400	100,000	Δ	Δ	Great Falls, S. C.–Durham, N. C.	210	S.T.	75–	600	1800	1 and 2	2	00 B. & S. 0.105	Cu. Al.	7	Cu. Al.	
3	Δ	Y	R.	28,000	G.E.	12,800	85,000	Δ	Δ	Shawinigan Falls–Montreal, Can.	87	S.T.	70.6–	520	1400	2	2	250,000 Circ. M. 0.196	Al.	19	Al.	
1	Δ	Y	D.	28,350	W.	33,000 16,500	.....	Δ	Y	San Francisquito–Los Angeles, Cal.	47	S.T.	50–	650	1750	2	4	250,000 Circ. M. 0.196. 300,000 Circ. M. 0.235	Cu.	19	Cu.	
1	Δ	Δ	No	40,000	G.E.	6,600	85,800	Δ	Δ	Khopoli–Bombay, India.	43	S.T.	66–160	500	1175	2	2	0.095	Cu.	....	.....	
...	....	....	....	.....	.....	.....	.....	....	....	Germany	155 65	.....	.....	645	.....	.....	...	.....	Cu.	....	.....	
1	Δ	Y	No	32,400	Br. Bov.	9,600	72,000	Δ	Y	Pescara River–Naples, Italy.	124	S.P.	59.4–65	656	1174	1	2	66 Sq. Mm. 0.102	Cu.	7	Cu.	
3	Δ	Δ	No	24,000	G.E.	13,200	88,000	Δ	Δ	New River–Roanoke, Va., Coalwood and Bluefield, W. Va.	75	W.P.	39–	250	1200	1	1	0 B. & S. 0.083	Al.	7	Al.	
1	Δ	Δ	No	55,600	W.	6,000	80,000	Δ	Δ	Lages River–Rio Janeiro, Brazil.	51	S.T.	56– 71	400 500	1935	2	4	000 B. & S. 0.132	Cu.	6	Hemp	
1	Δ	Δ	No	30,000	W.	25,000	80,000	Y	Δ	Sorocaba–Sao Paulo, Brazil.	56	S.T.	65	750	1200	2	4	00 B. & S. 0.105	Cu.	7	Cu.	
1	Δ	Y	D.	13,500	W.	6,600	88,000	Δ	Y	River Ouse–Hobart, Tasmania.	64	.....	.....	.....	.....	.....	...	.....	.....	...	.....	

RLD OPERATING AT AND ABO

WORLD by Selby Haar

29	30	31	32	33	34	35	36	
								TRANSMISSION L
Termini	Dist. of Trans., Mi.	Steel Towers or Wood Poles	Height, Ft.	Span		Circuits		
				Normal Ft.	Max. Ft.	Per Tow'r	To-tal	
Big Creek–Los Angeles, Cal	241	S.T.	Ca. 48–	660	2900	1	2	605, 0.47
Au Sable–Battle Creek, Mich	245	S.T.	40–167	500	600?	1	1	
Bishop–San Bernardino, Cal	239	S.T.	70–	660	1500	2	2	211, 0.1
Grace, Idaho–Salt Lake City, Utah	135	S.T.	82–	650	2200	2	2	25
Drum–Cordelia, Cal	110	S.T.	82–50–	800	2350	1 and 2	1	
Cheat Haven–Butler, Pa	106	S.T.	44– 80	528	.....	2	2	
Cleveland–Nashville, Tenn	140	S.T.	50–210	663	1903	1 and 2	2	
Shelburne Falls–Millbury, Mass	60	S.T.	75–	600	1200	2	2	
Lake Inawashiro–Tokio, Japan	144	S.T.	70–220	550	1530	2	4	
Croton–Grand Rapids and Muskegon, Mich	35	S.T.	53– 60	528	.....	1	2	
Niagara Falls–Toronto and St. Thomas, Canada	135 90	S.T.	61.3–170	550	1100	2	2	00
Lauchhammer Mines–Riesa, Germany	35	S.P.	60– 65	550	900	2	2	
Tallulah Falls–Lindale, Atlanta, Ga., etc.	210	S.T.	66–105	550	1200	2	2	00
Coosa River–Birmingham, etc., Ala	150	S.T.	65– 68	600–700	900–1200	2	2	
Keokuk, Ia.–St. Louis, Mo	144	S.T.	79–231	800	3300	2	2	30
Lauto–Siegfried, Pa	24	S.T.	78.5	600	2000	2	2	25
Cedar Rapids, Can.–Massena, N. Y	60	S.T.	70	660	.....	2	2	50
Coquila–Parral, Chihuahua, Mexico	157	S.T.	65– 90	575	1100	2	2	
Segre River–Barcelona, Spain	105	S.T.	65–	750	1500	2	4	
Tocopilla–Chuquicamata, Chile	86	S.T.	47–	656	.....	1	1	
Hill Creek–Oakland, Cal	.....	.....	.....	.....	.....	.....	.....	...
Stanislaus–San Francisco, Cal	138	S.T.	65–	850	1600	2 and 1	2	
Great Falls–Butte, and Anaconda, Mont	150	S.T.	45–	600	3034	1	2	
Dewitts Falls–Raleigh and Lumberton, N. C	96	S.T.	72.6–	650	1455	2	2	
Denwood–Denver, Colo	152	S.T.	44.2–	660	2900	1	1	
Big Bend–Oakland, Cal	154	S.T.	75–210	750	2740	2	2	
Great Falls, S. C.–Durham, N. C	210	S.T.	75–	600	1800	1 and 2	2	
Shawinigan Falls–Montreal, Can	87	S.T.	70.6–	520	1400	2	2	25
San Francisquito–Los Angeles, Cal	47	S.T.	50–	650	1750	2	4	25 0.1
Trombay–Bombay, India	43	S.T.	66–160	500	1175	2	2	
Germany	155 65	.....	.....	645	.....	.....	.....	...
Volturara River–Naples, Italy	124	S.P.	59.4–65	656	1174	1	2	
New River–Roanoke, Va., Coalwood and Bluefield, W. Va	75	W.P.	39–	250	1200	1	1	
Lages River–Rio Janeiro, Brazil	51	S.T.	56– 71	400 500	1935	2	4	
Itatinga–Sao Paulo, Brazil	56	S.T.	65	750	1200	2	4	
Mer Ouse–Hobart, Tasmania	64	.....	.....	.....	.....	.....	.....	...

BOVE 70,000 VOLTS

36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
ION LINES													LTG. PROT.		
	Conductors						Insulators				Overhead Ground Wires per Tower				
							Ordinary		Strain						
'o-al	Section-Gage and Sq. In.	Material	Strands	Core	Arrangement	Spacing, In.	Sections and Type	Manufacturer	Sections and Type	Manufacturer	Mat.-Size	Number	Type, Al. Cell, Horn, Res., Etc.	Manufacturer	Switchplant, Mfr.
2	605,000 Circ. M. 0.475. 78,000 Circ. M. 0.061	Al.	54 7	St.	H.	210	9-Susp.	Locke	11-Susp.	Locke	St. ¼ In.	1	Al.	W. G.E.	W. G.E.
1	O. B. & S. 0.083	Cu.	7	Cu.	·:	208 Slant 144 Vert.	10-Susp.	Oh. Br.	10-Susp.	Oh. Br.	No	No	Al.	G.E.	G.E.
2	211,160 Circ. M. 0.166. 34,970 Circ. M. 0.027	Al.	6 1	St.	·:	134 Min.	6-Susp.	Locke Oh. Br.	6-Susp.	Locke Oh. Br.	St. ¼ In.	1	Al.	G.E.	W. Bowie
2	250,000 Circ. M. 0.196	Cu.	12	Cu.	V.	156 Min.	9-Susp.	Thomas Oh. Br	11-Susp.	Thomas Oh. Br.	St. ¼ In.	2	Al.	G.E.	G.E.
1	00000 B. & S. 0.210	Cu. Al.	7 19	Cu. Al.	H. and V.	162 120	7-Susp.	Oh. Br.	8-Susp.	Oh. Br.	No	No	No	.....	P.G. & El.
2	O. B. & S. 0.083	Cu.	6	Cu.	V.	60	5-Susp.	Penna. China Co.	5-Susp.	Penna. Co.	Cu.-Clad 4	2	Al.	W.	W.
2	00 B. & S. 0.105	Cu.	7	Cu.	H.	126	7-Susp.	Oh. Br.	8-Susp.	Oh. Br.	St. 5-16 In.	1	Al.	G.E.	W. G.E.
2	00 B. & S. 0.105	Cu.	7	Cu.	V.	120	6-Susp.	Locke	7-Susp.	Locke	St. ¼ In.	1	Al.	G.E.	G.E.
4	100 Sq. Mm. 0.155	Cu.	7	Cu.	·:	122 Slant 120 Vert	7-Susp.	Special Thomas	8-Susp.	Special Thomas	St. ¼ In.	2	Al.	W.	W.
2	2 B. & S. 0.052	Cu.	6	Hemp	·:	96	5-Susp.	G.E.	5-Susp.	G.E.	No	No	Al.	G.E.	W.
2	0000 B. & S. 0.166 000 B. & S. 0.132	Cu. Al.	7	St. Cu. Al.	∴ and V.	128 96	8-Susp.	Locke Oh. Br. Hermsdorf	10-Susp.	Locke Oh. Br. Hermsdorf	St.	2 and 3	Al.	W. G.E.	W. G.E.
2	42 Sq. Mm. 0.066	Cu.	7	Cu.	·:	70	5-Susp.	Hermsdorf	6 7-Susp.	Rosenthal	St. 100000 Circ. M.	1	Horn and Res.	S.-S.	S.-S.
2	0000 B. & S. 0.166 00 B. & S. 0.105	Cu.	7	Cu.	V.	108	4 5-Susp.	Thomas Oh. Br.	5-Susp.	Thomas	St. 7-16 In.	2	Al.	G.E.	W. G.E.
2	00 B. & S. 0.105	Cu.	7	Cu.	·:	122 Slant 120 Vert.	6-Susp.	Locke Thomas Oh. Br.	7-Susp.	Locke Thomas Oh. Br.	St.	2	Al.	W. G.E.	W. G.E.
2	300,000 Circ. M. 0.235	Cu.	19	Cu.	V.	120	7-Susp.	Locke Oh. Br.	8-Susp.	Locke Oh. Br.	St. ½ In.	1	Al.	G.E.	G.E.
2	250,000 Circ. M. 0.196	Cu.	7	Cu.	V.	120	6-Susp.	Locke	Susp.	Locke	St. ¼ In.	2	Al.	W.	W.
2	500,000 Circ. M.	Al.	....	St.	V.	120	.....	.....	.....	.....	.....	1	Al.	.....	.....
2	Equi. Cu. 0000 B. & S. 0.166	Al.	7	Al.	·:	122 Slant 120 Vert.	5 7-Susp.	Locke Oh. Br.	9-Susp.	Oh. Br.	St. ¼ In.	3	Al.	G.E.	G.E.
4	0000 B. & S. 0.166	Cu.	7	Cu.	Δ	96	Misc. Pin	Several	7-Susp.	Several	St. ¼ In.	1	Al.	G.E.	G.E.
1	000 B. & S. 0.132	Cu.	7	Cu.	H.	155	Susp.	Locke	Susp.	Locke	St. ¼ In.	2	Horn and Res.	S.-S.	S.-S.
....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	00 B. & S. 0.105	Cu.	6	Hemp	V.	96	5-Susp.	Oh. Br. Locke	5-Susp.	Oh. Br. Locke	No	No	Al.	G.E.	G.E.
2	0 B. & S. 0.083	Cu.	6	Hemp	H.	124	6-Susp.	Oh. Br.	12-Susp.	Oh. Br.	St.	2	Al.	G.E.	W. G.E.
2	0 B. & S. 0.083	Cu.	6	None	V.	108	7-Susp. 6-Susp.	Thomas	7-Susp.	Thomas	St. ¼ In.	1	Al.	G.E.	G.E.
1	0 B. & S. 0.083	Cu.	6	Hemp	H.	132	4-Susp. 5-later	G.E.	4 5-Susp.	G.E.	No	No	No	No	G.E.
2	000 B. & S. 0.132	Cu.	7	.....	V.	120	5-Susp.	Oh. Br. Thomas	Susp.	Oh. Br. Locke Thomas	St. ¼ In	1	Al.	G.E.	G.E.
2	00 B. & S. 0.105	Cu. Al.	7	Cu. Al.	V.	124	4-Susp. 6-Susp. 4-Susp.	Thomas Oh. Br. Locke	5-Susp. 8-Susp. 5-Susp.	Thomas Oh. Br. Locke	St. ¼ In.	1	Al.	W. G.E.	G.E. W.
2	250,000 Circ. M. 0.196	Al.	19	Al.	V.	96	7-Susp.	Oh. Br.	8-Susp.	Oh. Br.	St. ¼ In.	2	Al.	G.E.	W.
4	250,000 Circ. M. 0.196. 300,000 Circ. M. 0.235	Cu.	19	Cu.	V.	120	7-Susp.	Oh. Br.	8-Susp.	Oh. Br.	St.	1	Al.	.....	W.
2	0.095	Cu.	....	.....	·:	126	6-Susp.	Bullers	7-Susp.	Bullers	Yes	.....	Al.	G.E.	G.E.
....	.....	Cu.	....	.....	.....	.....	5-Susp.	Hermsdorf	6-Susp.	Hermsdorf	.....	.....	.....	.....	.....
2	66 Sq. Mm. 0.102	Cu.	7	Cu.	.....	85	1-Pin	Richard Ginori	1-Pin	Richard Ginori	No	No	Horn & Water Jet	Br. Bov.	Br. Bov.
1	0 B. & S. 0.083	Al.	7	Al.	·:	96	4-Susp.	Thomas	5-Susp.	Thomas	St. ¼ In.	1	Al.	G.E.	G.E.
4	000 B. & S. 0.132	Cu.	6	Hemp	Δ	96	Misc. Pin	Thomas	5-Susp.	Locke	St. ¼ In.	1	Horn and Liq.	W. G.E.	W.
4	00 B. & S. 0.105	Cu.	7	Cu.	Δ	96	Misc. Pin	Several	5-Susp.	Several	St. ¼ In.	1	Al.	G.E.	G.E.
....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Al.	W.	W.

31	Pfalzwerke, A. G.	100,000	50	10,000	50,000	1915	S.	.....	....	....	..	.....	.....	.....	.....	.....	.....	.....	...	....	
32	Societa Italiana di Elettrochimica	88,000	42	23,280	29,100	1912	H.	8,200	249	420	H.	Riva	7,300	5,820	.80	6,600	Brown Boveri	3,600	1	Δ	
33	Appalachian Power Co.	88,000	60	20,610	75,000	1912	H.	6,000 3,500	51 37	116 97	V.	I.P. Morris	4,000 2,300	3,600 2,070	.90	13,200	G.E.	6,000	3	Δ	
34	Rio Janeiro Tramway, Light & Power Co.	88,000	50	48,800	90,000	1913	H.	19,000 8,700	1017	300	V.	Esch. W.	12,500 6,000	10,000 4,800	.80	6,300	W.	4,167 1,700	1	Δ	
35	Sao Paulo Electric Co.	88,000	60	30,000	50,000	1914	H.	14,500	600	600	H.	Voith	12,500	10,000	.80	6,300	W.	3,333	1	Δ	
36	Tasmania Hydroelectric & Metal Co.	88,000	50	.....	50,000	....	H.	.....	....	....	..	.....	1,350	1,700	.....	.....	W.	.....	1	Δ	
37	Mexican Light & Power Co.	85,000	50	58,500	100,000	1910	H.	7,000 13,000 to 14,000	1200 to 1300	300	V.	Esch. W.	7,500 12,500	6,000 11,250	.80 .90	4,000	S.-S. G.E.	2,000 6,000	1	Δ	
38	Toronto Power Co.	85,000	25	80,000	95,000	1914	H.	13,000 to 15,000	133 to 135	250	V.	Esch. W. I.P. Morris	7,500 10,000	6,000 8,000	.80	12,000	GE.	2,666 6,000	1 3	Δ	
39	Victoria Falls & Transvaal Power Co.	84,000	50	40,667	40,667	1913	S.	.....	....	1000	H.	A.E.G.	12,500 18,000	8,333 12,000	.67	5,000	A.E.G.	12,500 9,000	3	Δ	
40	Northern Power Co.	80,000	60	.....	.....	....	H.	.....	....	....	..	.....	.....	.....	.....	.....	.....	.....	...	....	
41	Energia Electrica de Cataluna.	80,000	....	.....	Over 100,000	? 1913	H.	.....	2620	...	..	.....	.....	.....	....	.....	.....	.....	...	..	
42	Swedish State Railways.	80,000	15	26,400	52,800	1915	H.	12,500	164	225	H.	.....	10,500	.....	.....	4,000	All. Sv. El. Akt.	.....	...	....	
43	Katsuragawa Denryoku Kabushiki Kaisha.	77,000	50	22,400	56,000	1912	H.	8,000	470	500	H.	Voith	7,000	5,600	.80	11,000	G.E.	3,500	1	Δ	
44	Southern California Edison Co.	75,000	50	20,000	.....	1907	H.	2x5375	874	250	H.	Al. Ch.	5,000	5,000	1.	2,300	G.E.	1,667	1	Δ	
45	Au Sable Electric Co.	72,000	30	3,000	3,000	1906	H.	7,000	38	225	H.	Leffel	1,500	1,500	1.	6,600 (6,000)?	W.	1,200	1	Δ	
46	City of Milan.	72,000	42	21,000	.....	1910	H.	12,000	1040	315	H.	Riva	8,750	7,000	.80	10,000	Br. Bov.	2,850	1	Δ	
47	Societa Generale Elettrica dell' Adamello.	72,000	42	Ca. 45,000	Ca. 75,000	1910	H.	6,500 5,000	2985 1542	420	H.	Esch. W. Riva	7,333 5,000	5,500 4,000	.75 .80	13,000 12,000	Br.-Bov. A.E.G.	2,700	1	Δ	
48	Montana Co.	70,000	60	21,500	60,000	1901	H.	1,000 4,000	40 65	157 225	H.	Day-Sm. S.M. Smith	750 2,800	750 2,800	1.	550 2,400	W.	1,250 2,000	1	Δ	
49	Hidroelectrica Espanola Molinar	70,000	50	27,000	27,000	1910	H.	7,200	217	428	H.	Voith	6,750	5,400	.80	7,000	S.-S.	6,750	3	Y	
50	Pennsylvania Water & Power Co.	70,000	25	71,500	Over 100,000	1910	H.	13,500 to 17,000	53 to 63	94 116	V.	I.P. Morris	7,500 10,000 12,000	7,500 10,000 12,000	1.	11,000	G.E. W.	7,500 10,000	3	Δ	
51	Guadalajara, Mexico.	70,000	50	Ca. 8,000	8,000	Ca. 1911	H.	4,000	215	375	H.	Esch. W.	3,500	3,500	1.08	10,000	S.-S.	4,000	3	Y	
52	Societa Elettrica Riviera di Ponente.	70,000	50 16⅔	27,000	60,000	1911	H.	10,000	230	500	H.	Riva	.....	7,500	.....	6,000	A.E.G. S.-S.	4,690 3,100	3 1	Y	
53	Swedish State Railways.	70,000	25	17,600	52,800	1915	H.	14,000	164	250	H.	.....	11,000	8,800	.80	10,000	All. Sv. El. Akt.	3,670	1	Δ	
54	City of Winnipeg.	66,000 to 72,000	60	15,000	48,000	1911	H.	5,200	45	164	H.	Boving	3,750	3,000	.80	6,600	Vickers	3,000	1		

.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	Germany	155 65	.....	.....	645	.....	.....	...	.....	Cu.	....	.....	...
vn eri	3,600	1	Δ	Y	No	32,400	Br. Bov.	9,600	72,000	Δ	Y	Pescara River–Naples, Italy	124	S.P.	59.4–65	656	1174	1	2	66 Sq. Mm. 0.102	Cu.	7	Cu.	...
E.	6,000	3	Δ	Δ	No	24,000	G.E.	13,200	88,000	Δ	Δ	New River–Roanoke, Va., Coalwood and Bluefield, W. Va	75	W.P.	39–	250	1200	1	1	0 B. & S. 0.083	Al.	7	Al.	
	4,167 1,700	1	Δ	Δ	No	55,000	W.	6,000	80,000	Δ	Δ	Lages River–Rio Janeiro, Brazil	51	S.T.	56– 71	400 500	1935	2	4	000 B. & S. 0.132	Cu.	6	Hemp	
	3,333	1	Δ	Δ	No	30,000	W.	25,000	80,000	Y	Δ	Sorocaba–Sao Paulo, Brazil	56	S.T.	65	750	1200	2	4	00 B. & S. 0.105	Cu.	7	Cu.	
	.....	1	Δ	Y	D.	13,500	W.	6,600	88,000	Δ	Y	River Ouse–Hobart, Tasmania	64	.....	.....	.....	.....	...	...	.....	.....	...	.....	...
E.	2,000 6,000	1	Δ	Y	D.	70,000	G.E.	3,000 210	81,000	Δ	Y	Necaxa–Mexico City, Mexico	169	S.T.	52–	500 750	1500	2	4	0000 B. & S. 0.166	Cu.	6	Hemp	
E.	2,666 6,000	1 3	Δ	Δ Y	No	51,000	G.E.	12,000	80,000	Δ	Δ	Niagara Falls–Toronto, Canada	80	S.T.	52– 65–	400 650	800	2	4	190,000 Circ. M. 0,149	Cu.	7	Cu.	
G.	12,500 9,000	3	Δ	Y	R.	61,000	S.-S. A.E.G W.	20,000	Ca. 80,000	Y	Δ	Vereenigung–Johannesburg, South Africa	30	S.T.	53– 71	500	.....	2	4	60 Sq Mm. 0.093	Cu.	Yes	.....	
.....	.....	...	.....	.....	.....	.....	W. G.E.	4,400 22,000	.....	.....	.....	Hannawa Falls–Potsdam, N. Y	60	S.T.	.....	550	.....	.....	.....	O. B. & S. 0.083	Al.	....	.....	...
....	.....	...	..	..	..	.....	....	11,000	.....	.....	.....	Spain	.....	.....	.....	.....	.....	.....	2	.....	.....	...	.....	...
kt.	.....	...	.....	.....	.....	.....	.....	15,000	.....	.....	.....	Porjus–Kiruna, Sweden	73.4	S.P.	.....	Ca. 640	.....	4	4	50-80 Sq. Mm. 0.077-0.124	.....	...	.....	...
E.	3,500	1	Δ	Y	R.	31,500	G.E.	11,000	70,000	Δ	Y	Komahashi–Tokio, Japan	48	S.T.	.....	450	850	1 and 2	2	18-No 12 B.W.G. 0.168	Cu.	18	Hemp	Tri gu
E.	1,667	1	Δ	Y	D.	20,000	G.E.	30,000 15,000 2,300	.....	Y Y Δ	Y	Kern River–Los Angeles, Cal	117	S.T.	30– 60	700	1500	2	2	0000 B & S 0.166	Cu	7	Cu	
	1,200	1	Δ	Δ	No	3,600	W.	6,600	66,000	? Δ	? Δ	Rogers Dam–Muskegon, Mich	66	W.P.	35-75	132	.....	1	1	2 B. & S. 0.052	Cu.	No	Cu	
v.	2,850	1	Δ	Y	R.	25,650	Br. Bov.	8,650	65,000	Δ	Y	Grossoto–Milan, Italy	93	S.P.?	65.6	656	1066	2	4	80 Sq. Mm. 0.124 Sq. In.	Cu.	19	Cu.	
Bov. G.	2,700	1	Δ	Δ	No	40,500	G.E.	13,000	60,000	Y	Y	Cedegolo–Milan, Italy	72	S.P.	60–	607	.....	1	2	79 Sq. Mm. 0.122	Cu.	....	.....	
	1,250 2,000	1	Δ	Δ	No	25,000	W.	2,400	60,000	Δ	Δ	Canyon Ferry, Hauser Lake–Butte, Mont.	100	W.	40–	110	200	1	2	0 B. & S. 0.083	Cu.	7	Cu.	
S.	6,750	3	Y	Y	No	27,000	S.-S.	6,000	60,000	Y	Y	Molinar–Madrid, Spain	158	W.P.	40– 50	328	....	2	2	50 Sq. Mm. 0.155	Cu.	1	Cu.	
E. .	7,500 10,000	3	Δ	Y	R.	71,500	G.E. W.	13,000	60,000	Y	Δ	Holtwood, Pa.–Baltimore, Md	40	S.T.	40–	500	1750	2	4	300,000 Circ. M. 0.235	Al.	....	Al.	
S.	4,000	3	Y	Y	No	12,000	S.-S.	20,000 3,000	67,500	Y	Y	Compania Hidro-Electricia e Irrigadora del Chapala S. A	180	S.T.	59	645	1,000	2	2	99,000 Cm. 0.098 50 Sq. Mm.	Cu.	....	Cu.	
.G. S.	4,690 3,100	3 1	Y	Y	R.	60,000	A.E.G.	12,000	.....	Y	Y	S. Damazzo–Novi, et al., Italy	155	S.P.	39.4	494	2300	2	4	78 Sq. Mm. 0.121 Sq. In.	Cu.	....	Cu.	
Sv. kt.	3,670	1	Δ	Y	D.	11,000	.....	.....	.....	.....	.....	Porjus–Kiruna, Sweden	73.4	S.T.	.....	625	740	2	2	40 Sq. Mm. 0.062	Cu.	....	.....	
kers	3,000	1	Δ	Δ	....	18,000	W.	12,000	60,000	Δ	Δ	Point Dubois–Winnipeg, Can	77	S.T.	42-90	600	939	2	2	278,600 Circ. M. 0.219	Al.	19	Al.	

...any	155 65	.....	.....	645	.....	.....	....	.....
...ara River–Naples, Italy	124	S.P.	59.4–65	656	1174	1	2	66 Sq. M 0.102
... River–Roanoke, Va., Coalwood and ...nefield, W. Va	75	W.P.	39–	250	1200	1	1	0 B. & S 0.083
...a River–Rio Janeiro, Brazil	51	S.T.	56– 71	400 500	1935	2	4	000 B. & 0.132
...caba–Sao Paulo, Brazil	56	S.T.	65	750	1200	2	4	00 B. & 0.105
...r Ouse–Hobart, Tasmania	64	.....	.....	.....	.....	.....	....	.....
...xa–Mexico City, Mexico	169	S.T.	52–	500 750	1500	2	4	0000 B. & 0.166
...ara Falls–Toronto, Canada	80	S.T.	52– 65–	400 650	800	2	4	190,000 Circ 0,149
...enigung–Johannesburg, South Africa	30	S.T.	53– 71	500	.....	2	4	60 Sq Mn 0.093
...nawa Falls–Potsdam, N. Y	60	S.T.	.....	550	.....	.....	....	O. B. & S.
...	.....	.....	.....	.....	.....	.....	2	.....
...s–Kiruna, Sweden	73.4	S.P.	.....	Ca. 640	.....	4	4	50-80 Sq. 0.077-0.12
...ahashi–Tokio, Japan	48	S.T.	.....	450	850	1 and 2	2	18-No 12 B. 0.168
... River–Los Angeles, Cal	117	S.T.	30– 60	700	1500	2	2	0000 B & 0.166
...rs Dam–Muskegon, Mich	66	W.P.	35-75	132	.....	1	1	2 B. & S 0.052
...oto–Milan, Italy	93	S.P.?	65.6	656	1066	2	4	80 Sq. Mi 0.124 Sq.
...golo–Milan, Italy	72	S.P.	60–	607	.....	1	2	79 Sq. Mi 0.122
...yon Ferry, Hauser Lake–Butte, Mont.	100	W.	40–	110	200	1	2	0 B. & S 0.083
...inar–Madrid, Spain	158	W.P.	40– 50	328	....	2	2	50 Sq. Mi 0.155
...twood, Pa.–Baltimore, Md	40	S.T.	40–	500	1750	2	4	300,000 Circ 0.235
...pania Hidro-Electricia e Irrigadora del ...hapala S. A.	180	S.T.	59	645	1,000	2	2	99,000 Ci 0.098 50 Sq. Mi
...Damazzo–Novi, et al., Italy	155	S.P.	39.4	494	2300	2	4	78 Sq. Mi 0.121 Sq.
...jus–Kiruna, Sweden	73.4	S.T.	.....	625	740	2	2	40 Sq. Mi 0.062
...nt Dubois–Winnipeg, Can	77	S.T.	42-90	600	939	2	2	278,600 Circ 0.219

.....	Cu.	....	.....	.....	.....	5-Susp.	Hermsdorf	6-Susp.	Hermsdorf	.....	.....	.....	.....	.....
66 Sq. Mm. 0.102	Cu.	7	Cu.	.....	85	1-Pin	Richard Ginori	1-Pin	Richard Ginori	No	No	Horn & Water Jet	Br. Bov.	Br. Bov.
0 B. & S. 0.083	Al.	7	Al.	·:	96	4-Susp.	Thomas	5-Susp.	Thomas	St. ¼ In.	1	Al.	G.E.	G.E.
000 B. & S. 0.132	Cu.	6	Hemp	Δ	96	Misc. Pin	Thomas	5-Susp.	Locke	St. ¼ In.	1	Horn and Liq.	W. G.E.	W.
00 B. & S. 0.105	Cu.	7	Cu.	Δ	96	Misc. Pin	Several	5-Susp.	Several	St. ¼ In.	1	Al.	G.E.	G.E.
.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Al.	W.	W.
0000 B. & S. 0.166	Cu.	6	Hemp	∴	72	3-Pin	Thomas	3-Pin	Thomas	St.	1	Al.	G.E.	G.E.
0,000 Circ. M. 0,149	Cu.	7	Cu.	Δ	72 96	Misc. Pin	Locke Thomas	5-Susp.	Locke	St. ¼ In.	1	Horn	G.E.	S.-S. G.E.
60 Sq Mm. 0.093	Cu.	Yes	.....	·:	110	6-Susp.	G.E.	6-Susp.	G.E.	St. 35 Sq.Mm.	3	Horn & Res. Al.	A.E.G. G.E.	S.-S. A.E.G. W.
B. & S. 0.083	Al.	....	.....	.....	108	5-Susp.	Locke	6-Susp.	Locke	Yes	2	.....	.....	.....
.....	.....	....	.....	.....	.....	Susp.	.....	Susp.	.....	.....	.....	.....	.....	.....
80 Sq. Mm. 0.077-0.124	.....	....	.....	.....	.....	Susp.	.....	Susp.	.....	.....	.....	.....	.....	.....
No 12 B.W.G. 0.168	Cu.	18	Hemp	Triangular	84	4-Pin	Nippon Toki G. K.	.....	.....	St. 3 B.&S.	1	Al.	G.E.	G.E.
0000 B & S 0.166	Cu	7	Cu	∴	72	4-Pin and Susp.	Oh. Br. Thomas Locke	Pin	Oh. Br.	No	No	Multiplex Al.	G E.	G.E.
2 B. & S. 0.052	Cu.	No	Cu	Δ	80 Av.	3-Pin	Locke	3-Pin	Locke	St. No. 10	1	Stat. Int. & M. G.	W.	W.
80 Sq. Mm. 0.124 Sq. In.	Cu.	19	Cu.	∴	63	Pin	Richard Ginori	Pin	Richard Ginori	No	No	H&R., W.J., Cyl.	Several	Br. Bov.
79 Sq. Mm. 0.122	Cu.	....	.....	·:	75	4-Pin	Osculati and Carini	4-Pin	Osculati and Carini	No	No	Horn and Res.	A.E.G.	A.E.G.
0 B. & S. 0.083	Cu.	7	Cu.	∴	72	1 Pc. Glass	Hemingray	Glass	Hem.	No	No	Al.	W.	W.
50 Sq. Mm. 0.155	Cu.	1	Cu.	∴	71	Pin	Hermsdorf Rosenthal	Pin	Hermsdorf Rosenthal	No	No	Horn and Res.	S.-S.	S.-S.
00,000 Circ. M. 0.235	Al.	....	Al.	V.	84	5-Susp. 7-Susp.	Oh. Br.	6-Susp. 8-Susp.	Oh Br.	St. ¼ In.	1	Al.	G.E. W.	G.E.
99,000 Cm. 0.098 50 Sq. Mm.	Cu.	....	Cu.	·:	185	3-Susp.	Hermsdorf	6-Susp.	Hermsdorf	.....	1	Horn & Resist	S.-S.	S.-S.
78 Sq. Mm. 0.121 Sq. In.	Cu.	....	Cu.	Δ	65	Pin	Richard Ginori	Pin	Richard Ginori	No?	.....	Horns, W.J., Con.	A E.G. Friburg	A.E.G. Br. Bov.
40 Sq. Mm. 0.062	Cu.	....	.....	H.	158	6-Susp.	.....	6-Susp.	.....	35 Sq. Mm. Iron	1	Horn and Res.	.....	.....
278,600 Circ. M. 0.219	Al.	19	Al.	Δ	72	4-Pin	Locke	4-Pin	Locke	Yes in exp. places	1	Al.	W.	W.